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Journal

OF THE

Royal Army Medical Corps

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Journal
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Original Communications.

FIELD AMBULANCE SECTIONS IN A MOUNTAIN OPERATION.

BY

Lieutenant-Colonel R. JOHNSTON,
Royal Army Medical Corps,

AND

Captain J. F. MAWE,
Royal Army Medical Corps.

Introduction.

The mountainous character of the country in North-Central Italy suggests that the lessons learned by an Indian Field Ambulance during a small, yet interesting, operation which took place during the Italian summer campaign of 1944, may prove of assistance to similar units who may find themselves facing like problems in the future.

Military Situation.

The area of operations was roughly quadrilateral, about 10,000 yards broad by 13,000 yards in length, the boundaries being formed by four sets of roads, second class in character but negotiable by any transport. The area was bounded by two rivers, and was hilly, but it could everywhere be traversed by strenuous walking, and no actual climbing was necessary, although some of the hills were higher than 1,400 metres. It was devoid of roads, and boasted only a few rough tracks fit for mule traffic. The gradients were steep, and it was intersected by many valleys, the streams at the bottom of which were dry. Roughly 20 per cent of the district was wooded.

At the commencement of the operation, the enemy was in unknown strength, holding roughly the whole area, including four-fifths of the lateral roads; the road at the base alone was fully cleared.

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It was decided to attack with an Indian Infantry Brigade, with a view to clearing this area, the continued enemy occupation of which was holding up major operations.

The plan envisaged that during the earlier stages of the operation, the only possible means of supply, and of evacuation of casualties, could be by mules, but that to maintain the force, a single line Jeep track must be driven forward as fast as possible, along the axis of advance, Jeep Maintenance Areas being established further and further forward as the troops advanced, pack mules being used forward of the J.M.As.

In connexion with the Jeep track, one might mention that its discovery was due to some very fine photographic reconnaissance work on the part of the R.A.F., who had "spotted" a footpath as it wound through enemy territory, in the hills.

Medical Arrangements.

The problems of collection, treatment and evacuation of such casualties as occurred in this operation, were solved in the following way.

Seven squads of Field Ambulance stretcher bearers, in addition to two ambulance mules, were attached to each of two forward Battalions while the Regimental stretcher bearers were further augmented on the scale of four squads per Battalion, from B Echelon personnel. These extra squads proved invaluable.

The two Companies of a Field Ambulance, less the above-mentioned S.B. personnel, were organized into four Light Sections. The M.D.S. of the unit was not "open" and, consequently, it was possible to give each Section two Medical Officers, and additional equipment.

Each Section was capable of forming an A.D.S. on the line of evacuation. Previous liaison with Brigade H.Q. had indicated that the foremost Section should be on mules, the two middle Sections should be "Jeep-borne" and leap-frog each other, while the fourth was at road-track junction with heavy transport, including ambulance cars.

A. *Mule Sections.*—Shortly after the operation commenced, however, it was deemed advisable to "mule" a second Section, and thus fully establish the mobility of the foremost Field Ambulance post; one Section moving forward and opening, when the rearward Section closed, while the mules returned to lift it forward.

Personnel approximated to that of the recognized Mule Light Section, but the scale of equipment was somewhat increased. Twenty-four load-carrying mules were provided, all being used to move either Section. Accommodation was in 180 lb. tentage (2).

B. *Jeep-Borne Section.*—The Jeep Section as under, amply satisfied all requirements of high mobility and capacity to hold casualties. It proved capable of efficiently fulfilling its assignment under all the conditions encountered in this operation.

An important factor in its make-up was the employment of a 40 ft. by 40 ft. canvas shelter, which, erectable by a trained team within ten to fifteen minutes,

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was capable of holding up to thirty casualties at any one time. No large vehicles from which one would normally erect this type of shelter, of course, were available, but it was successfully "set up" with the aid either of trees or of an additional set of "goal posts" (*vide* photograph).

Penthouse and Jeep Truck.

Transport was provided as follows:—

1 Recce Jeep for the Coy. Comd's liaison work.

4 load-carrying Jeeps and trailers (each having capacity to carry 1,000 lb. weight of equipment).

9/15 stretcher-carrying Jeeps (according to the operational necessity at the time) from Divisional sources.

The majority of the equipment was carried in the trailers, and load tables were as under:—.

Load Table for Jeeps and Trailers

No. 1 (*Medical*)

Medical and surgical panniers, Ind. type; dressing pannier; medical comforts pannier; 40 ft. by 40 ft. canvas tarpaulin pent-house complete with metal and wooden uprights, rope, angle irons and mallet; Red Cross, large size 40 ft. x 40 ft.

No. 2 (*Cooks*)

Portable oil cooker; cook's apparatus; oven; Chapati plate; 2 camp kettles; 2 4-gall. tins kerosene; 30 2-gall. water tins; 1 1-gall. container; rot-proof cover 10 ft. x 18 ft.; 1 day's hard scale and current day's rations.

No. 3 (*General*)

Reserve of 20 blankets; 500 shell dressings in hessian; Yakdan containing Ordnance equipment, i.e. 2 Primus stoves, basin, soap,

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brushes, 3 hurricane lamps, 1 pressure lamp, bed-pan and urine bottle, string, &c.; 40 gas capes or ground sheets; 6 stretchers; 1 night sign; 4 Thomas splints complete; 20 pieces Cramer's wire.

No. 4 (*General*)

80 lb. tent; 8 picks and shovels; 1 axe, felling; 2 sets stretcher trestles, light metal type $3/8$ in. steel tubing; 1 medical companion; 4 shell dressing haversacks; 1 surgical haversack; 2 boxes (12 sets) plasma; 2 folding chairs; 2 folding tables; canvas 40-gall. water tank; 1 heating stove; 4 unit signs; 1 Red Cross flag.

Additional load is elastic, according to the length of operation and weather conditions.

In this connexion, one would repeat that the operation took place during the summer, and bivouacs and heavy kit for personnel were not carried, while light-scale clothing was in issue.

Due to the speed with which the Jeep track was constructed behind the infantry, it was found possible to get the Ambulance Jeeps up to the Mule A.D.S. at all times, and finally, even beyond it. It had been envisaged, however, that the Mule Section might have had to leave the Jeep track temporarily, and this would have meant the establishment of an Ambulance Jeep Post on the track, with additional S.B.s maintaining the "carry" between the Mule Section and the Jeep Post. The Jeep Section normally worked one and a half miles behind the Mule A.D.S.

Ambulance Jeeps.—These vehicles, fitted to carry stretchers, proved quite indispensable in this operation, and casualties were eventually being evacuated on them over a distance of 6/7 miles, and their absence would have entailed a hand- or mule-carry over this distance.

In this connexion, an expression of opinion at the conclusion of the operation, by the Brigade Commander, is worthy of mention. "The ambulance mule should not be used as a normal method of evacuation. It is most uncomfortable and a vulnerable method of transport, and should only be used when the lengths of 'carry' prohibit such 'carries' by S.B. personnel."

The casualties on the whole arrived at roadhead A.D.S. in surprisingly good condition, considering the roughness of the track.

The comment by the Brigade Commander especially applies to the unsatisfactory transportation of casualties by mules along narrow hill paths in the wooded country.

C. *Road-Head A.D.S.*—From Jeep A.D.S. to roadhead A.D.S. the time taken varied from one to two hours, in accordance with the distance involved and the congestion on the track. On arrival at roadhead, however, dressings were finally inspected, resuscitation instituted if necessary, food, tea and cigarettes given to those who required them, and, after triage, cases were evacuated by ambulance car.

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Summary.

(1) The operation involved the establishment of a chain of medical posts along a mountain track, passable, as far as M.T. was concerned, only to Jeeps, and, finally, one of these posts was established by this means at a height of over 4,000 feet.

(2) The Jeep Section, as constituted above, is a light, highly mobile, flexible unit, and its exploitation proved of great value in mountainous parts of Italy. It showed itself, in this operation, to be an invaluable link between mule and heavy transportation of casualties, and permitted an efficient system of medical evacuation not otherwise possible.

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THE OCCURRENCE AND IDENTIFICATION OF THE TYPHUS GROUP OF FEVERS IN SOUTH EAST ASIA COMMAND.

Written in 1945

BY

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THE purpose of this paper is to place on record the occurrence, geographical distribution, epidemiological features and the results of certain laboratory investigations on cases of the typhus group of fevers, particularly of scrub typhus (tsutsugamushi fever[1]) encountered in the Eastern Theatre, in the years 1941-44.

Before the Japanese threat to India in 1941, fevers of the typhus group were relatively uncommon among Indian and British troops in India. The total number of cases for the Army in India reported during 1934 was 108, of which 35 were undoubtedly OXK in type (Boyd, 1935). In Burma and Ceylon, typhus was a medical curiosity (Kundu, 1932; Nicholls, 1940).

Outbreaks occurred among troops in Burma and Eastern India from 1941 onwards, and at one period of the Burma campaign scrub typhus ranked after malaria, as the most serious medical problem. Five thousand cases occurred in 1944, with some 350 deaths. The notable feature at first was the occurrence of a series of sharp outbreaks, with intervening quiescent periods during which few cases were reported. Thus there were outbreaks in Burma (Meiktila) in September 1941 (107 cases); in Calcutta in 1942 (20 cases); at Ranchi early in 1943 (33 cases); and at Jhingergacha near Calcutta in the following autumn (58 cases). The year 1943 closed with a sudden outbreak in a British regiment south of Imphal (121 cases) and an explosive outbreak in Ceylon, when over 750 cases were admitted to hospital within a week.

It was apparent from these early outbreaks that the disease showed a marked seasonal variation. This was corroborated by subsequent experience, and the second half of the year came to be known as the "typhus season." As operations spread in the later months of 1944, into the Kabaw valley and across the Chindwin, and down the "railway corridor" in northern Burma, the incidence of the

[1]The identity of scrub-typhus with the classical tsutsugamushi of Japan and Formosa is accepted. The term "scrub-typhus" is used in this paper, since it was obtained in wartime usage.

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disease markedly increased and ceased to fluctuate widely. In August that year there were 800 cases and thereafter between 600 and 700 cases per month occurred regularly till the end of the year. Such figures had never previously been recorded.

Owing to the fact that military operations of some complexity were occurring throughout the period under consideration, considerable difficulties existed in collecting accurate figures for epidemiological analysis. The available data indicate only in broad outline the incidence of infection in the principal foci in Burma, India and on the Indo-Burma border. Table I, and the Chart and Map, summarize the main outbreaks and indicate the numbers of cases and geographical location of the units involved. Table II indicates the mortality rates. Experience in Burma will first be described, as a majority of the cases of typhus occurred either in that country or on the Indo-Burma frontier.

Burma and the Indo-Burma Frontier.

The Outbreak of 1941.—This, the earliest of any importance to be described in the Army, was reported by Gurbuxsh Singh (1945). In September 1941, 107 cases occurred in a rural area near Meiktila in Central Burma. Clinically the disease was scrub typhus and local necrotic lesions of the skin were observed in 36 per cent of cases. Serological tests showed agglutination of Proteus OXK to significant titre in 97 per cent. of cases. Two patients died and the epidemic corresponded in all but mortality with the disease as later encountered. All but two of the patients belonged to one unit which proved to be infested with lice, and a company of that unit which was free from lice was also free from disease. These observations, coupled with the occurrence of weakly positive agglutination of OX19 suspensions in 16 cases, suggested to Gurbuxsh Singh that the louse was a possible vector, but no further evidence in support of this hypothesis was recorded.

The Burma Retreat, 1942.—The extent to which fevers of the typhus group occurred during the retreat from Burma in the summer of 1942 remains unknown. Then, and in the months that followed, medical officers were generally unfamiliar with this group of fevers, and laboratory facilities were lacking. After the fall of Burma, "typhus" was first recognized in stations where there were laboratories, such as Ranchi, Calcutta and Imphal.

Manipur State and the Kabaw Valley, 1943.—In the first nine months of 1943 only some twenty cases, and these from widely scattered areas around Imphal, were admitted to hospital. In October and November of that year the first big outbreak of scrub typhus drew attention to the importance of this disease in future operations in Burma (Tattersall and Parry, 1945). On October 11, 1943, a battalion of a British regiment arrived from a non-endemic area and patrolled down the Tamu Road some five miles north of Moreh, in the hills above the valley of the Yu river. Two companies patrolled a certain hill feature, a ridge about two miles in length, the original jungle on which was replaced by rank grass, scattered stunted trees, and occasional young palms. On November 2, three weeks later, the unit left the area. Cases of scrub typhus began to occur

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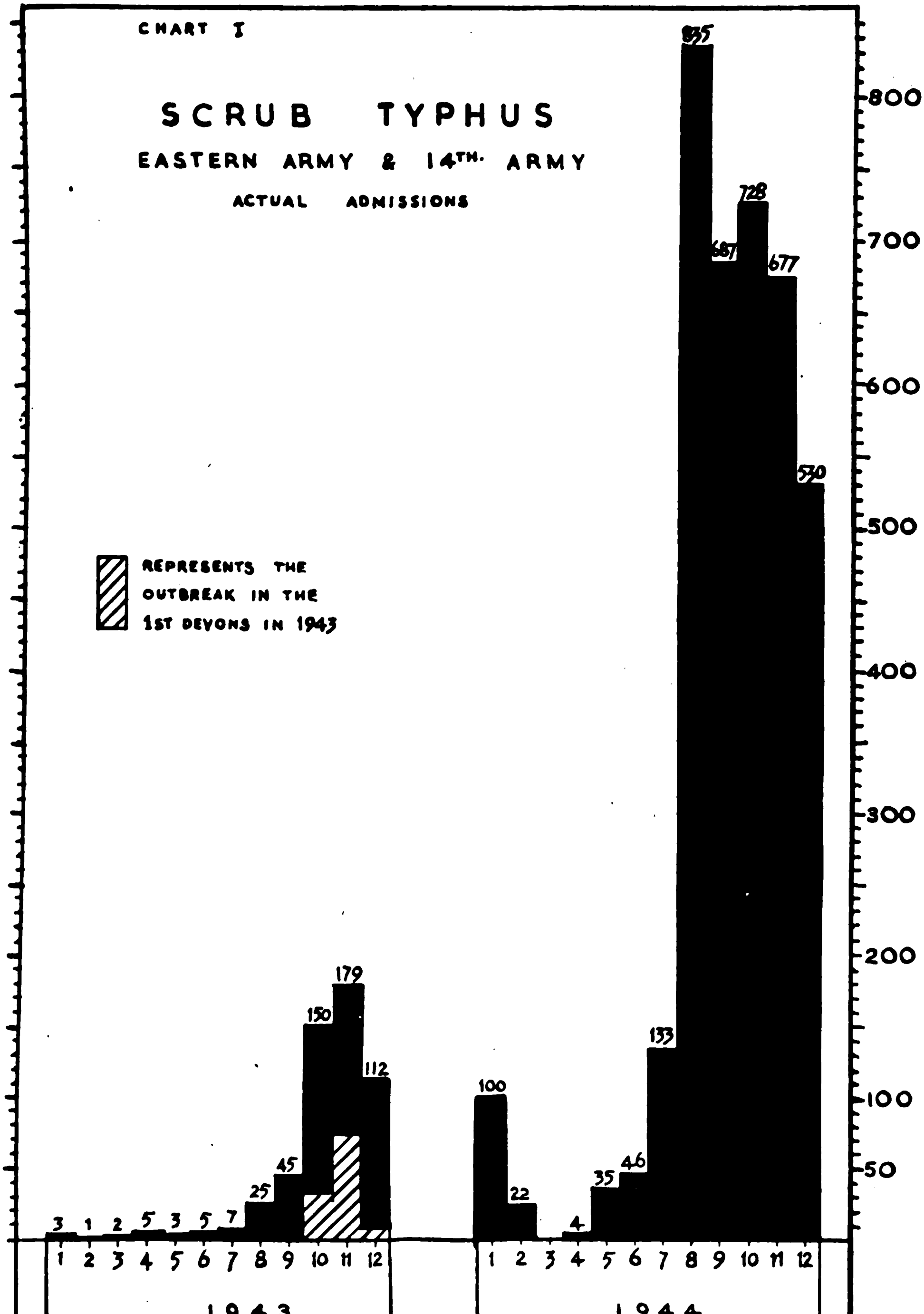

Chart I—Scrub Typhus in Eastern Army and 14th Army, 1943-1944.

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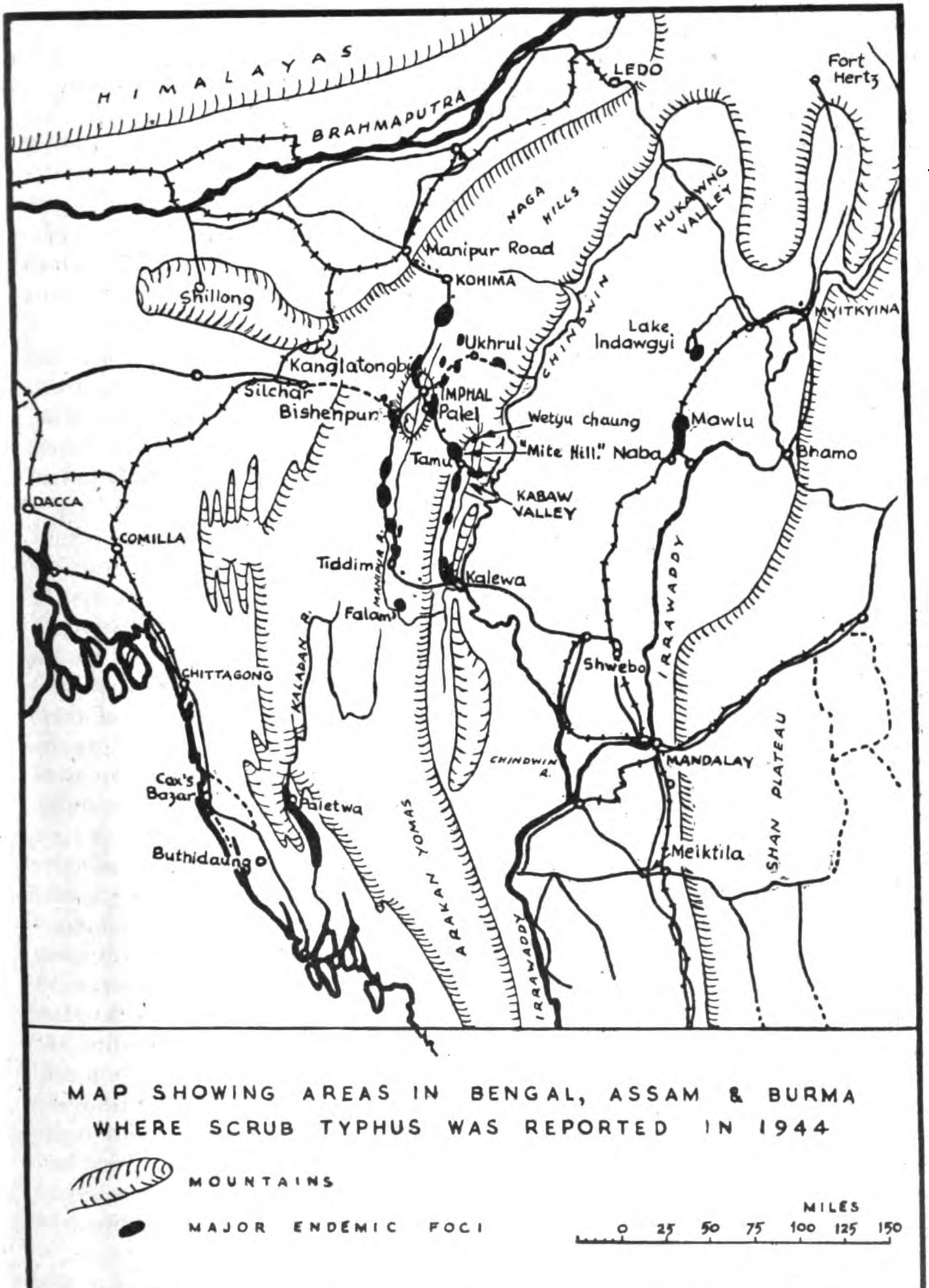

Map of Bengal, Assam and Burma—Scrub Typhus in 1944.

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on October 20 and continued until November 19, seventeen days after the unit left the area. The maximum daily incidence occurred from October 23 to 27, corresponding to an incubation period of twelve to sixteen days. In all, 121 cases were reported, the majority of which occurred among the companies which had patrolled the ridge, later known as "mite hill."

This outbreak was the subject of detailed clinical and pathological studies, referred to in the second part of this paper, which fully confirmed that the disease, hitherto commonly known as scrub typhus, differed in no essential particular from tsutsugamushi fever. (During the dry season about three months after the outbreak, an extensive fire occurred on "Mite Hill." After the monsoon in August 1944 adults of *T. deliensis* were found in the soil of the burnt site.)

The Burma Fronts, 1944.—On the Northern and Central Fronts, cases occurred in appreciable numbers wherever troops were engaged, with the overwhelming majority among those operating along the roads and tracks radiating from Imphal. The Southern front (the Arakan), on the other hand, was almost free from scrub typhus until the operations in the valley of the Kaladan in November 1944.

A feature common to the regions where infection occurred was the "scrub" country, consisting of areas of rank grassy wasteland which resulted from old jungle clearings. The focal incidence of infection was demonstrated by the occurrence of isolated groups of cases from various areas along the tracks south of Imphal. It appeared that localized infected patches of ground existed within wide areas of wasteland and workers in this theatre have claimed that it is possible to pin-point such highly localized "islands." The significance of these observations was explored in the hopes that the application of air-photography to the survey of typhus country might prove of value in assessing areas of maximum risk (Lieutenant-Colonel J. R. Audy, R.A.M.C., personal communication).

An example, typical of many, illustrating the discrete localization of infective foci was described to one of us (M. H. P. S.) by the officer commanding a field battery, which encamped for ten days on the banks of a small stream (*chaung*) in the Kabaw valley. The officers' lines were situated some 30 or 40 yards away from the main body. Seven cases of "fever" occurred among the personnel occupying the officers' lines—three officers and four batmen—two weeks after arrival in the camp. In five of them, according to the officer commanding the unit, a diagnosis of scrub typhus was subsequently made. He himself contracted the disease twelve days after leaving the area, up to which time, he stated, no case of suspected scrub typhus was reported from the main body, although over 100 men had been engaged on jungle exercises. (All clothing had been treated with dibutylphthalate.) Although there is little reason to doubt the reliability of this account, it was unfortunately impossible to confirm the details by examination of the clinical records of the patients.

(*a*) *Central Burma Front.*—From November 1943, up to the time of the withdrawal on to the Imphal plain the following March, some 240 cases were

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reported among troops operating down the roads leading to Tiddim and Tamu, South of Imphal. During the following two months, while the forces were concentrated on the Imphal plain, no case was notified. With the raising of the siege in May, scrub typhus reappeared among patrols operating along the roads leading out of Imphal, and over one hundred cases were reported in May and June (1944) from this area.

There were few cases of scrub typhus among the troops advancing from Manipur Base (Dimapur) to the relief of Kohima in May. Only two cases were reported in the following month during operations to open the Imphal-Kohima Road. In July (1944) the incidence began to rise steeply as strong forces moved south of Imphal and nearly 200 cases were reported. In August over 700 cases occurred and this figure was almost equalled in September. The main foci of infection were along the tracks leading from Imphal to Ukrul and Bishenpur, the Tiddim and Tamu Roads and the valley of the Yu River. Operations in the Kabaw valley and towards the Chindwin resulted in nearly 1,400 cases in October and November, and during these two months, over 100 further cases occurred among troops operating up and down the Imphal-Kohima road.

(*b*) *North Burma Front.*—Wingate's Special Force was flown into Northern Burma (north of Katha) in March 1944 and scrub typhus was not reported before May, when some 50 cases were flown out to hospitals in North Assam. Fifteen of these patients died. From inquiries from men of the force and from available accounts, it is probable that a number of men died of scrub typhus in Burma, before its occurrence was recognized. The foothills to the south and south-east of Lake Indawgyi were the most likely foci of infection. A few cases (11) also occurred in May among units of the Fort Hertz garrison while camping on the Myitkyina—Fort Hertz Road. Altogether between May and September 1944, 132 cases of scrub typhus were reported from the units of Special Force. In addition some 200 cases had occurred among American Forces operating further north near Shaduzup between March and May that year.

Special Force was relieved in July 1944 by a British Division, and at first very few cases were reported as they advanced down the "railway corridor" towards Sahmaw. Only 18 cases were reported during August, and 33 the following month. Early in October, as operations proceeded south of Mawlu towards Pinwe, the incidence suddenly rose and during the last quarter of the year, 231 cases were admitted to hospital. The peak period was the latter half of November and December, after which the disease ceased as abruptly as it had begun. The following is taken from an unpublished report by the A.D.M.S. of the Division. "All these cases occurred between Mawlu and Naba, in a type of jungle which could hardly be called 'scrub.' It varied between tall trees meeting overhead and a certain amount of undergrowth, to thick, inpenetrable jungle as was encountered at Pinwe." There was no evidence to show that there ever had been any local populace on the main axis of advance and only a limited number of troops patrolled to outlying villages. In striking contrast to the earlier cases referred to above in the Wingate Force, the mortality was only 2·6 per cent.

(*c*) *South Burma Front* (*The Arakan*).—Only a few cases of scrub typhus

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occurred among our troops in the Arakan during 1944. Under 30 cases were reported up to the end of October, including a small very localized outbreak in Cox's Bazaar. The valley of the Kalapanzin River, where the troops had been mainly operating, was thus not an infective focus. In November, however, as operations spread into the neighbouring valley of the Kaladan, nearly 100 cases occurred among the West African Forces.

Enemy Accounts of Typhus in Burma.—It is highly probable that Japanese experience resembled our own, and that scrub typhus occurred among the enemy during their occupation of Burma. But from captured enemy documents it appears, curiously enough, that the Japanese did not recognize the disease as such. The most comprehensive account described some 80 cases which occurred mainly in and around Mandalay in the autumn of 1943. The clinical description sustained a diagnosis of scrub typhus. Serologically OXK titres were low and of 44 results reported only 7 cases agglutinated this suspension significantly. Only one test for each patient, however, is recorded, and there is no note of the day of the disease on which it was done. The mortality was 7·4 per cent, and the gross post-mortem findings were those of our Burma disease. The results of their animal experiments and the alleged finding of Rickettsiæ in liver and spleen smears from a fatal case have cast some doubt on the competence of the authors, who concluded that "the disease was a typhus-like illness which is identical neither with tsutsugamushi, epidemic typhus nor tropical typhus in its narrow sense." (Translation of captured enemy document.) It was also called by the Japanese "Burma eruptive fever."

After the Japanese surrender, Lieutenant-Colonel Hayakawa, of the Japanese Medical Service, stated that he had later examined sera and guinea-pigs, inoculated from these Mandalay cases, at Singapore. He found high titres against OXK and established a strain of Rickettsia.

India and Ceylon.

The Ranchi Outbreak of Early 1943.—Thirty-three cases of typhus-like fever occurred among British troops engaged in jungle training near Ranchi in the early weeks of 1943. The clinical features closely resembled those of scrub typhus and were described by Bowes (1943). Serologically, the majority of these cases belonged to the indeterminate group, with agglutination of two or more *Proteus* strains. They thus differed from any series which has been met further east (*see* Table I).

Typhus in the Calcutta Area, 1942-43.—Fevers of uncertain origin, conforming to clinical descriptions of scrub typhus, had been reported from the Calcutta area as far back as 1912, when Bradley and Smith (1912) first suggested a diagnosis of "typhus" for an isolated case. No cases had been reported from this area, however, for nearly twenty years before the outbreak of war. Cases of "typhus" in the Army were notified from June 1942 onwards. They could be divided into two groups, viz. sporadic cases occurring throughout the year and a series of unit outbreaks of varying size confined to the second half of the year (Parker, 1944). Two examples of the latter are described (*see* Table I). In the

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autumn of 1942, 16 cases occurred in a British battalion stationed in Calcutta. Eight of the patients were living in a large building in a densely populated part of the town. With the exception of one, a patient from Ranchi, all cases showed well-marked agglutination of OXK, and all were clinically similar to those seen in subsequent outbreaks. There were 4 deaths. This was an instance of scrub typhus breaking out in the suburbs of a large town. Eleven cases had occurred under similar conditions the previous year among Greek sailors billeted in the same area. Sporadic cases during 1942 numbered 35. The largest unit outbreak occurred the following year under conditions more usually associated with scrub typhus. In the autumn of 1943, 58 cases were reported among troops operating near the village of Jhingergacha, about 80 miles from Calcutta. All except 3 were of OXK type. The area, which had been vacated by the local population, consisted of patches of cultivated land and bamboo clumps, which the troops had been engaged in clearing. Troops had occupied the site for several months before cases occurred.

A further 130 cases were reported from Calcutta itself during 1943. These were mostly isolated cases and scattered over many different units. Lusk (1945) has described the Jhingergacha series together with 54 sporadic cases he observed in Calcutta during the same period (June-December 1943). Clinically all cases from both series were similar and the majority agglutinated OXK. They differed from the later cases of scrub typhus elsewhere by absence of glandular swellings and local primary lesions. A rash was observed in only 9·6 per cent, but most of the patients were Indians, in whom slight rashes would not have been readily seen. There were 17 deaths in all, giving a mortality rate of 14·9 per cent for the combined series. It is probable that a number of milder cases at Jhingergacha were missed before the true nature of the disease was appreciated.

In 1942 and 1943 among the sporadic cases, there were thirty-three clinically indistinguishable from scrub typhus, but with predominant agglutination of proteus strains other than OXK, or with a mixed response (*see* Table I). There was no fatality among these cases which occurred mainly during the second half of each year.

Ceylon and the Maldives.—A remarkable outbreak occurred in Ceylon early in January 1944. Over 750 cases of scrub typhus resulted from a four-day exercise in December 1943, in a circumscribed jungle clearing in the southern coastal region of the island at Embilipitiya. The majority of the cases occurred among East African troops (713 cases) but 43 were among the British. This outbreak conformed in all but mortality (which was under 2 per cent) to the scrub typhus of Burma. Local primary lesions were noted in a high proportion (85 per cent).

On the small island of Addu Attol (Maldive Islands) in the Indian Ocean, some 500 miles south-west of Ceylon, scrub typhus is endemic. From February to August 1944, 114 cases were recorded, which gave a figure of approximately 100 cases per 1,000 of the garrison per annum. No case was reported during the last four months of the year. This was almost certainly due to the fact that

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troops in the early months had been engaged in clearing gun sites, preparing ammunition dumps, slit trenches, etc. These had, for strategic reasons, to be sited in scrub, regardless of the typhus risk. Once the work was finished, the incidence of the disease rapidly declined. The local inhabitants appear to be immune.

Clinical and Pathological Findings.

An analysis of the signs and symptoms in a number of outbreaks in this theatre has been made by British and American workers. In the vast majority of fevers where Proteus OXK has been agglutinated, the clinical features have been remarkably uniform, though variations have been recorded especially with regard to the incidence of adenopathy, primary lesions and rash. Tattersall (1945) has analysed 1,000 cases. His findings conform in all essentials to the classical descriptions of tsutsugamushi fever of the Japanese writers. Post-mortem appearances, though not sufficiently characteristic to be diagnostic, have also conformed to descriptions of this disease. Macdonald, working at the Central Military Pathological Laboratory at Poona, succeeded in demonstrating Rickettsiæ in the endothelial cells of the precapillaries of the brain, from a fatal case from Imphal. These observations were confirmed by Lewthwaite, who considered the organisms morphologically indistinguishable from *R. tsutsugamushi.*

Serological Observations.

The Weil-Felix Reaction.—The Weil-Felix reaction has not in our experience been superseded as the simplest test for separating scrub typhus from other fevers of the typhus group and has proved technically satisfactory. Table I details a summary of the results of the Weil-Felix reaction in the early outbreaks. From this, it will be seen that in the majority of cases, agglutinins to Proteus OXK suspension appeared during the progress of the disease. An analysis of the results of the Weil-Felix test in 2,919 cases of typhus reported in 1944 showed that 91 per cent of the sera agglutinated OXK in preponderance (Table III).

Towards the end of the second week significantly raised titres (in excess of 1/125) of agglutinins were usual but peak readings were not encountered until the third week, after which titres again fell to reach normal levels by about the eighth week or later. Titres of 1:10,000 (OXK) were found on several occasions and one of 1:64,000 was encountered once though figures in excess of 1:5,000 were relatively uncommon. An occasional case diagnosed as typical scrub typhus on clinical grounds gave a negative Weil-Felix response

In a minority of cases, agglutinins to OX2 or OX19 or to both, either separately or in addition to OXK, occurred, though not usually in titres high enough to cause confusion. During 1944, 9 per cent of the 2,919 cases examined gave reactions according to the following three groups (*see* Table III):—

(1) Cases with a predominant titre against OX2 (2 per cent).

(2) Cases with a predominant titre against OX19 (3 per cent).

(3) Cases with a mixed agglutinin response to two or more suspensions (4 per cent).

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In the outbreak reported from Ranchi (Bihar) in 1943 the majority of cases agglutinated OX19 and OX2 to high titres. In Calcutta, cases with a predominant OX19 response occurred sporadically and the existence of such serological varieties of typhus in India is, of course, well known (Boyd, 1935).

Sera of different titres were selected from cases of the first outbreak at Imphal and submitted to laboratories in India and elsewhere for confirmation. Reports on 11 sera examined in the United Kingdom (Army Emergency Vaccine Laboratory), Washington (The National Institute of Health, Bethesda) and Cairo (Central Pathological Laboratory M.E.F.), were in general agreement with our field laboratory results (*see* Table IV).

Rickettsial Agglutination.—Rickettsial agglutination tests using antigens prepared from louse-borne and flea-borne strains of typhus were carried out by the Army Emergency Vaccine Laboratory (through the courtesy of Major-General L. T. Poole) and by Major C. E. van Rooyen, R.A.M.C., at Cairo. Unfortunately it has been impossible hitherto to prepare a suspension of *R. tsutsugamushi,* with which agglutination tests can be performed.

In all, eight sera from typical cases at Imphal were examined. Van Rooyen found that agglutination, described as "slight," occurred to a titre of 1 : 400 against a strain of flea-borne typhus in one of the three sera submitted to him. All five sera examined at the Army Emergency Vaccine Laboratory showed only traces of agglutination in low dilution against one or other antigen prepared from louse-borne and flea-borne strains. The highest titre observed was a "trace" of agglutination against a louse-borne strain in a dilution of 1 : 80 which occurred in one case. The results are given in Table IV. It was concluded from these results that "the low titres obtained and the poor quality of agglutination did not suggest any antigenic relationship between the OX19 and the OXK groups of typhus." (Report from the Army Emergency Vaccine Laboratory 1944.)

Rickettsial Complement-fixation Tests.—Complement-fixation tests were carried out on eight sera, also taken from Imphal cases. Five were examined at the Army Emergency Vaccine Laboratory, where only louse-borne and flea-borne strains were used in the preparation of antigens. These sera failed in all cases to fix complement with these antigens in the lowest dilution tested (1 : 5).

Three sera were examined at the National Institute of Health, Bethesda, using antigens prepared from louse-borne typhus, flea-borne typhus, Rocky-mountain spotted fever and scrub typhus strains. The scrub typhus strain, originally isolated from a case in New Guinea, was that known as the "Karp" strain, which came into prominence in connexion with the preparation of the lung-tissue vaccine against scrub typhus, later to be used in this Theatre.[1] All three sera examined fixed complement to high titre with the antigen prepared

[1]An account of field trials of the vaccine, giving inconclusive results because of the low incidence of scrub typhus encountered during the trials, has since been published by Card, W. I., and Walker, J. M. (1947): "Scrub Typhus Vaccine—Field Trials in South-East Asia," *Lancet,* 1 (13), 481.

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from the "Karp" strain. Results were uniformly negative with all other antigens (*see* Table V). From these results it was concluded by Topping (1944) that the Imphal cases were "immunologically closely related to those occurring in New Guinea and called 'scrub typhus.'"

Animal Experiments.

In December 1943 an appeal was received from the American Typhus Commission then in Cairo, for strains of Rickettsia from scrub typhus cases. At that time no such strains were being maintained in India or the United Kingdom. In December 1943 Major Parker, working in Calcutta, succeeded in demonstrating scanty rickettsial bodies in guinea-pigs inoculated by one of us (M. H. P. S.), with ground blood clot taken from cases at Imphal, and had produced a specific iridocyclitis in rabbits by injection of infected guinea-pig peritoneal fluid into the interior chamber of the eye. At about this time we were fortunate in obtaining the assistance of Dr. S. R. Savoor, who had collaborated with Dr. Lewthwaite in pioneer work on scrub typhus in Malaya. Following the same technique (Lewthwaite and Savoor, 1936) Parker and Savoor readily established strains from the Imphal and Calcutta cases in rabbits and white mice, by passage from guinea-pigs inoculated intraperitoneally with human blood drawn early in the disease. The virus was also established in the rabbit by inoculation of infected human blood direct into the anterior chamber of the eye. It was thus possible to meet the request of the American Typhus Commission, to whom strains were despatched in rabbits, early in January 1944. There was no difficulty subsequently in establishing strains from all the main outbreaks by the same procedures. Representative strains from the Burma border (Imphal cases) and Bengal, were despatched for further study to van Rooyen at Cairo where, after further passage, they were sent to the United Kingdom. Strains have also been sent in white mice to Dr. Craigie in Toronto. From reports by Parker (1944) Lewthwaite and Savoor (personal communications to M. H. P. S.) the strains isolated were indistinguishable in their experimental pathology from those isolated from scrub typhus elsewhere and known as *R. tsutsugamushi*. Van Rooyen and Danskin (1944) transmitted the infection to Egyptian rodents, using the gerbille and jerboa, in which the appearance of the organism was stated to be identical with that described by Lewthwaite and Savoor (1936) in Malayan scrub typhus.

Discussion.

The widespread occurrence of scrub typhus in the Eastern Theatre is one of the most notable features of the medical history of the recent war. The experiences in Burma described above have been similar to those of the Australians and Americans in the Pacific Theatres.

It appears that the disease has existed "silently" in widespread areas in this part of Asia, as a rickettsial infection of mites and their rodent hosts (Lewthwaite, 1945). The sudden invasion of these areas by men in unprecedented numbers has led to the partial supplanting by man of the rodent as a host,

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with the consequent flare-up of the human disease. This scrub typhus may be said to be essentially an "occupational" disease, and cases occur only when circumstances require man to enter such infected areas. In climates such as those of Malaya and Addu Atoll, where there is no marked wet and dry seasons, cases occur throughout the year. In monsoon climates such as that of Burma, the risk of entering infected areas is associated with the rainy season. The reason for this is probably connected with factors associated with the life-cycle of the mite and evidence from current work of the Scrub Typhus Research Laboratory in South East Asia indicates that the density of the mite population on rodents trapped in infective areas near Imphal is significantly higher in the wet than in the dry season (personal communication to M. H. P. S. from Lieutenant-Colonel Audy, R.A.M.C.).

The frequent suggestion that the Japanese invasion was responsible for the spreading of the infection is untenable, because the disease has occurred in many localities which have not been occupied by the enemy.

From the investigations carried out on cases of the OXK serological type in different epidemics in this theatre, this disease appears to be identical with tsutsugamushi fever. As far as is known there are no essential differences clinically or serologically between tsutsugamushi disease and scrub typhus as found elsewhere.

The precise nature of the other serological types of typhus-like fevers found in this theatre is obscure. They have formed a small and numerically unimportant minority of the cases reported, and have occurred sporadically throughout the greater part of the area. By analogy with descriptions of typhus-like fevers elsewhere, it may be assumed that the cases with a preponderating agglutination of OX19 are probably endemic murine flea-borne typhus, while those with a mixed response probably belong to the same group as one form of endemic typhus that occurs in Southern India, which may in fact be a member of the tick-borne Rocky Mountain Spotted Fever group. Cases with a predominant OX2 response probably also belong to the same group and do not form a separate entity. A recent report on the results of complement-fixation tests carried out on sera from three cases of the indeterminate group, seen in Mysore, indicate that such cases are immunologically similar to the Rocky Mountain Spotted Fever group (Topping, Heilig and Naidu, 1943).

While the typhus group of fevers of Eastern India and Burma can be readily grouped according to the predominant Weil-Felix response, it is curious that conclusive direct evidence for the incrimination of the various insect vectors concerned in these diseases is lacking.

Summary.

(1) Outbreaks of scrub typhus in Bengal, Assam, Burma and Ceylon during military operations in 1941-44 are described.

(2) Their relationship to season and terrain and the striking focal nature of infective localities are discussed.

(3) The clinical features of the disease as described by various workers

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and confirmed by the authors' experience are indistinguishable from those of tsutsugamushi fever in Japan as described in the literature.

(4) Serological studies showed a predominant OXK agglutination in the great majority of cases. The significance of the agglutination of other suspensions is discussed.

(5) Rickettsiæ demonstated in the brain of a fatal case of scrub typhus were pronounced indistinguishable morphologically from *R. tsutsugamushi* by competent observers.

(6) A study of rickettsial agglutination did not suggest any antigenic relationship between the OX19 and OXK groups of typhus.

(7) Rickettsial complement-fixation tests confirmed that the scrub typhus on the Indo-Burma border is immunologically closely related to the scrub typhus of New Guinea.

(8) Strains of Rickettsiæ have been isolated from cases occurring in Calcutta, Imphal, Ceylon and Burma. Laboratory investigations of strains from Calcutta and Imphal, both in India and the United Kingdom, have shown them to be indistinguishable from *R. tsutsugamushi*.

(9) It is considered that clinically, serologically and bacteriologically, the scrub typhus of this theatre is identical with the classical tsutsugamushi disease.

ACKNOWLEDGMENT.

We are much indebted to the many medical officers of South East Asia Command, too numerous to mention individually by name, for their co-operation in this study, and especially to Dr. Janet Niven, Dr. Norman H. Topping, Dr. R. Lewthwaite, Dr. S. R. Savoor, Lieutenant-Colonel C. E. van Rooyen and Lieutenant-Colonel J. R. Audy.

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Tables follow on pages 20-22.

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TABLE I.—SUMMARY OF MAIN FEATURES OF OUTBREAK OF "TYPHUS" FEVERS IN 1942–44

Country	Date	Area	Geographical features	Approx. Nos. of troops at risk	Month	Number of cases (approx.)	Cases with predominating titres OXK	Cases with predominating titres Other strains
Burma and Indo-Burma Border	1941	Meiktila	Grassy scrub	Battalion	Sept.	107	97%	
	1942	Unknown						
	1943	"Mite Hill" (Nr. Tamu)	Abandoned clearings	Battalion	Oct.–Nov.	121	100% of sera tested	
Central Front	1944	Roads radiating from Imphal to Tiddim - Tamu Ukhrul and Kale valleys	Abandoned clearings and riverside scrub in mountains and valley-plains	2 Corps	Nov. 43–Mar. 44	240		
					May–June	100		
					July	200		
					Aug.	700		
					Sept.	700		
					Oct.–Nov.	1,400		
					Dec.	450		
						3,790	Over 90%	
	1944	Lake Indawgyi Myitkyina	Abandoned clearings and riverside scrub	Division (Wingate's)	May–Sept.	132		
Northern Front	1944	South of Mawlu	Clearings, streamside scrub, possibly also dense jungle	Division	Aug.	18		
					Sept.	33		
					Oct.–Dec.	231		
						282		
Southern Front	1944	Arakan: Kaladan Cox's Bazaar	River valley and abandoned clearings in low hills	Division	Nov.	130	Over 90%	
				2 Battalions	—	14		
India	1942	Calcutta	Urban and suburban wasteland	Battalion	March–Dec.	35 (Sporadic)	80%	10·5%
					Aug.–Nov.	22 (Unit outbreaks)		
	1943	Calcutta	Ditto	Brigade	All year	108 (Sporadic)	73%	20·7%
					June–Dec.	22 (Unit outbreaks)		
	1943	Jhingergacha (near Calcutta)	Wasteland among paddy villages	Brigade	June–Dec.	58	95%	5%
	1943	Ranchi	Wasteland near foothills	Battalion	Jan.	33	Nil	nearly 100%
Ceylon	1944	Embilipitiya	Abandoned clearings	Division	Jan.	756	Majority of sera tested	Nil
Maldives	1944	Addu Attol	Scrub within coastal fringe of palms	2 Battalions	Feb–Aug.	114		

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TABLE II.—MORTALITY OF SCRUB TYPHUS IN FOURTEENTH ARMY 1944.

Month	Total cases	Total deaths	Case mortality per cent. by categories Total	B.O.R.s	I.O.R.s	E.A.O.R.s
January	100	3	3	2·6	2·1	Nil
February	21	2	9·5	—	22·5	Nil
April	3	2	66·6	—	—	Nil
May	35	3	8·6	40·0	4·5	Nil
June	46	2	4·4	—	7·7	Nil
July..	133	26	19·5	20·2	18·2	Nil
August	835	81	9·7	19·5	7·6	4·3
September	687	80	11·64	18·9	9·26	12·55
October*	528	60	11·75	10·37	13·08	7·15
Total 9 months	2,388	259	11·29	12·76	9·32	7·91

*Incomplete.

TABLE III.—ANALYSIS OF POSITIVE WEIL-FELIX TESTS CARRIED OUT IN LABORATORIES OF FOURTEENTH ARMY IN 1944.

	Predominant titres as shown OXK	OX2	OX19	Mixed
No. of cases ..	2,674	54	72	119
Per cent. (approx.)	91	2	3	4

TABLE IV.—RESULTS FROM AGGLUTINATION TESTS USING PROTEUS RICKETTSIAL ANTIGENS, CARRIED OUT IN DIFFERENT LABORATORIES ON SERA FROM CASES FROM THE INDO-BURMA BORDER.

Patient	Imphal Laboratory (Parry) Antigens OX19	OXK	Cairo Laboratory (van Rooyen) Antigens OX19	OX2	OXK	Epidemic Rickettsiæ	Murine Rickettsiæ
(1) G. K. ..	25	10,000	50	50	6,400	—	400
(2) K. ..	0	5,000	0	0	6,400	—	—
(3) M. ..	0	560	0	0	500	—	—

Patient	Imphal Laboratory (Parry) Antigens OX19	OXK	Emergency Vaccine Laboratory, United Kingdom Antigens OX19	OX2	OXK	Epidemic Rickettsiæ	Murine Rickettsiæ
(1) T. ..	0	10,000	0	0	5,000	40 tr.	40 tr.
(2) B. ..	0	10,000	0	0	5,000	20 tr.	20 tr.
(3) F. ..	0	2,500	0	0	1,280	20 tr.	20 tr.
(4) H. ..	25	7,300	0	80	10,000	0	20 tr.
(5) B. ..	0	220	0	0	80	80 tr.	0

Patient	Imphal Laboratory (Parry) Antigens OX19	OXK	Washington Laboratory (Ida Bengston) Antigens OX19	OX2	OXK	
(1) N. H. ..	0	64,000	160	—	20,480	Rickettsial agglutination not done
(2) C. ..	0	40,000	0	—	20,480	
(3) W. ..	0	2,500	120	—	2,560	

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TABLE V.—RESULTS OF COMPLEMENT-FIXATION TESTS CARRIED OUT AT NATIONAL INSTITUTE OF HEALTH, BETHESDA, BY DR. N. H. TOPPING ON CONVALESCENT SERA OF CASES FROM INDO-BURMA BORDER.

COMPLEMENT-FIXATION TITRES.

Patient	*Serial No.*	1/4	1/8	1/16	1/32	1/64	1/128	1/256	1/512	1/1024	1/2048	*Weil-Felix OX19*	*Weil-Felix OXK*
Cook N. H.	10870											1 : 160	1 : 20,480
Antigen :													
Rocky Mt. spotted fever		0	0	0	0	0	0	0	0	0	0		
Endemic typhus		0	0	0	0	0	0	0	0	0	0		
Epidemic typhus		0	0	0	0	0	0	0	0	0	0		
Scrub typhus (Karp)		++++	++++	++++	++++	++++	++++	++++	++++	++++	++++		
Pte. C.	2067330											0 :	1 : 20,480
Antigen :													
Rocky Mt. spotted fever		0	0	0	0	0	0	0	0	0	0		
Endemic typhus		0	0	0	0	0	0	0	0	0	0		
Epidemic typhus		0	0	0	0	0	0	0	0	0	0		
Scrub typhus (Karp) ..		++++	++++	++++	++++	++++	++++	++++	0	0	0		
Pte. W.	5624329											1 : 120	1 : 2,560
Antigen :													
Rocky Mt. spotted fever		0	0	0	0	0	0	0	0	0	0		
Endemic typhus		0	0	0	0	0	0	0	0	0	0		
Epidemic typhus		0	0	0	0	0	0	0	0	0	0		
Scrub typhus (Karp) ..		++++	++++	++++	++++	++++	++++	++++	++++	0	0		

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BURMA RETREAT 1942.

(*Compiled from letters written by* (*then*) *Brigadier T. O. Thompson, D.D.M.S., Burma, to* (*then*) *Brigadier H. C. D. Rankin, D.D.M.S., G.H.Q., India.*)

DATED MARCH 20, 1942.

PART I.

THANK you for your letter of the 8th, received to-day. I don't know whether the blood transfusion sets have arrived. We have not yet sorted out the medical stores and there are still shiploads and many waggon-loads to come into Mandalay. We are, however, taking up the blood and plasma bank project. This will be run by McDonald, Lane, French, Malone and other experienced officers.

British beds are difficult. I have increased them on paper and most hospitals have British sections made up somehow or other. For example, the old B.M.H., Maymyo, now No. 8 Burma General Hospital with nominally 70 British beds now has 189 cases of whom 25 to 30 are officers.

I have changed the names of the Station and Military Hospitals to "Burma General Hospitals," this is still awaiting official sanction.

The list now is:—

No. 1 Burma General Hospital (combined) previously Toungoo, now Kalaw but moving to Shevebo.
No. 2 B.G.H. (combined) Mingaladon-Tadagale-Lunatic Asylum Prome.
No. 3 B.G.H. Mulmein-Pegu-Maymyo.
No. 4 B.G.H. Taunggyi—moving to Shevebo.
No. 5 B.G.H. Mandalay.
No. 6 B.G.H. Meiktila.
No. 7 B.G.H. Ind/Bur. Maymyo.
No. 8 B.G.H. British Maymyo.

In addition, the Medical Stores have been designated:—

Base Depot Medical Stores—possibly to Myingyan, probably to Shevebo.
No. 1 D.M.S. Mandalay for civil supply.
No. 2 D.M.S. at Prome, possibly to Myingyan, Mandalay or Shevebo.
No. 13 D.M.S. is at Mandalay. No. 12, if it ever comes, will probably go to Shevebo.

Laboratories: The three small laboratories at Mingaladon, Toungoo and Taunggyi become Nos. 1, 2 and 3 Field Laboratories to be brought up to scale in due course.

Evacuation of Casualties from Magwe.—We got your message too late to lay on the evacuation to Magwe. I had located 2 B.S.S. there but it is 150 miles by road or three days by river from the nearest hospitals. Messages are taking from two to five days to get through. I now hope to lay on a

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regular small stream of cases from Base hospitals to Magwe and then cases can be evacuated whenever opportunity arises.

Hospital Stores, Ambulance Cars, etc.—We got some of these in the last flight of ships before the final closure. The ambulance cars were invaluable and 21 M.A.C. came to life in a diminutive form. I fear a number left on the ships.

I have now got five hospital ships (!!!) going on the river and staging sections and 8 C.C.S. have been used for this. My stock of staging sections is fully occupied.

Medical Stores.—I think these will be fairly correct. We packed and loaded practically everything at Rangoon and it is being sorted out at Mandalay. Some waggons, loaded after much labour, were never sent up the line. Major Saghal did well and Captain Holman, R.A.M.C., with Watts of the I.M.D. did marvels in the last days of the debacle. Holman unearthed Rangoon Corporation dust and filth carts, Diesel driven, and used them to get away to the railway and even, finally, up to Prome.

Outline of Events.—Tevoy and Mergui were evacuated at very short notice and should have warned us how completely any civil organization would break down at the least danger. We got a few medical personnel from those, but practically all equipment was lost. Barrett and Ingram have since done well commanding hospitals. Ingram is now A.D.M.S. Corps.

Then came the attack on Mulmein in which some medical units just faded out while others did well. De Souza got most of his stuff away when evacuated to Pegu where he opened up as a going concern in five days. He got his nursing staff away complete but the civil hospital lost practically everything. Its Sisters are now marooned somewhere on an island. The Field Ambulance lost its entire equipment and many Burmans deserted. Leane, who commanded the Field Ambulance, was nearly drowned at Moulmein. Later, as O.C. 3 Ambulance Train he has been an outstanding success and evacuated over 1,000 casualties to Prome.

After considerable difficulty we are succeeding in forming a "Medical Branch." Jeejibhoy, a lawyer, has been appointed an additional Staff captain to deal with medical recruitment and we are now fairly well off for medical officers.

The Burma Hospital Corps have been a difficulty—no recruits and desertions. It has been decided that it is not worth while to recruit any Burmans. The Manchi mines at Taunggyi have closed and we are trying to get recruits from the old soldiers, Indian and Gurkhas, employed there.

Meanwhile we have been diligently trying to find locations up-country for the various Rangoon medical units and depots. Medical stores were to be located at Mandalay and Myinggyain with 13 Depot at Mandalay and 12, when it comes, at Thasi. A Depot at Gyogon (Insein) was to remain as a Depot near Rangoon. This was the last to be packed and eventually gave us considerable trouble to get away. We got everything away except for some four or five truck-loads, including a lot from the civil hospitals, chemists'

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shops and masses of medical goods lying in and around the docks. This is now being sorted out at the agricultural college, Mandalay.

I had realized that Mingaladon Hospital was definitely dangerous, being only 400 yards from the aerodrome and R.A.F. installations. I managed to get one wing of the lunatic asylum, Tagdale, and, after magnificent work and endless struggle for transport, got the whole hospital and 150 patients moved out. Damreel, left in charge of a detention hospital, moved that out to the Gloster lines just before dark the very night the Japs put sticks of bombs across the hospital and blew in several of the wards.

The quiet period came to an end on the Pegu line and then, after the attack, followed the retreat over the Sittang Bridge. We lost a lot of equipment and several ambulance cars. McKenzie, McLeod and Gamble were captured at the Sittang bridgehead when well in the rear of the main part of the Division. A Burma rifle unit gave way completely to a surprise attack from heavy woods to the north of the bridge. The position was restored in a counter-attack but McKenzie and Gamble were carted away. McLeod escaped and is now in hospital at Yananyauna, recovering and nearly ready to resume command. Previously near Kyato he was driving an Ambulance car full of wounded when they were machine gunned from the air and everyone except himself killed.

Fortunately McKenzie had sent back both Ambulance Trains and one and a half Field Ambulances over the Sittang to Wah and 1 C.C.S. to Pegu, before this happened. Poor McKenzie, he had repeatedly said he would end up by being captured and that he was too old for that sort of thing. [He survived many trials and tribulations and is now well and flourishing.—Ed.]

There were many unfortunate incidents and many locals were treacherous and unreliable. The O.C.? D.W.R., wounded, swam the Sittang only to be stabbed to death on our side by some treacherous beasts. On the whole our fellows did their job well and there were many fine incidents. O'Neill with 23 Field Ambulance did good work at Pegu. Ambulance Trains 1 and 2 got several loads away despite some muddles.

No. 3 Ambulance Train had been fitted out at Mandalay and went to Rangoon to equip. Leane was in command, with him Miss Flint as Sister-in-charge and three Keren nurses. We eventually got it up to Insein on the Prome line where, with two European drivers and reliefs from 1 Field Hygiene Section, they are still running on the Prome line.

Trains were all clearly marked with Red Crosses. No. 3 was passed several times by Japanese planes at low altitudes in broad daylight and was not harmed in any way. These trains have been of immense value. Owing to marauding and looting No. 3 carried a stock of rifles and No. 1 Field Ambulance going up-river in H.S. "Mysore," and 2 Bur. G.H. have also been armed.

In 17 Div. at Pegu, 39 Field Ambulance had lost 4 officers, many men and practically all its equipment. Annaswami, the O.C., had become officiating A.D.M.S. and Eastcott, his second in command, the D.A.D.M.S. They amalgamated 37 and 39 Field Ambulances and they, with over 1,500 armed

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men, were got back through Taukhyan, north of Rangoon, to Prome and north to Yenangaung. 37 Field Ambulance, practically up to strength, is running part of the B.O.C. hospital as a glorified M.D.S. Annaswami is to be relieved by McAlevey from 8 C.C.S. and will then reform 39 Field Ambulance. Irvine will replace McAlevey.

Then the line was cut north of Pegu and we had to get all our patients away via the Prome side. Fortunately 22 M.A.S. was available north of Rangoon and cleared the Pegu Field Ambulances in a couple of trips.

Meanwhile R.A.M.C. officers and O.R.s arrived on the "Neuralia" with medical units and personnel on other ships but could not be landed. We got some 300 cases on the "Neuralia." McIver, on the "Neuralia," and Wilmot and Khan (I.M.S.) on shore did good work. Unfortunately McIver took with the patients a number of patent steel stretchers which fitted some Wayne type ambulance cars we had acquired from the "Friends Ambulances" who have been doing good work with the Chinese.

By this ship I unfortunately agreed to evacuate the Q.A. and V.A.D. staff of No. 2 Bur. G.H. and have regretted it ever since. Can I have them back?

Before this the civil evacuation of Rangoon took place, a real exodus with those who should have controlled often leading the Van. Things went to pieces and the whole City emptied and looting of empty premises became rife. All the fine A.R.P. schemes, the Civil Defence, City organizations, Police, etc., just disappeared while labour, sweepers, dhobis, bhistis and servants all joined the trek. The water supply, electricity and telephones continued and the railways carried on with skeleton staffs, mainly European or Anglo-Indian or Anglo-Burman. Both the latter classes have many times showed up well in medical units.

The civil hospital closed down all-standing; we opened an improvised hospital for civil cases in Sale Barracks. This took shooting casualties and motor accident cases.

Some time before this our Rear Headquarters had closed and been sent off by train—61 coaches, the longest train which ever left Rangoon—to Maymyo.

2 Bur. G.H. went by train to Prome and opened in the school.

8 C.C.S. took over Tadagale, moved to the H.S. "Mysore" which was loaded with patients and stores, and finally to Prome and Mandalay. A light section went by road to Tharrawaddy as an intermediate stage to Prome. It did excellent work for the retirement of 17 Div.

No. 1 Field Ambulance, commanded by Captain Marcus Paw (A.B.R.O.(M)) with one and a half years' service, took over Tadagale as an A.D.S. His M.D.S. was at 23 milestone on the Prome road, north of the Pegu-Prome fork. This young officer was excellent. He had started with a unit brought back from Mulmein without equipment or transport and deficient in men. At this stage his unit was self-mobile with "acquired" transport, had 5 Ambulance cars, nearly full equipment and well up to strength in men; a remarkable achievement. I put him up to Field rank. He did very well in

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the battle for the "break away" after the final evacuation and his unit is now in Corps Reserve at Allaymayo. Cumming from 2 C.C.S. has gone to command it.

With Rangoon empty and awaiting dissolution, 17 Div. were fighting around Pegu, and we were still in Rangoon as an advance H.Q. with Rear H.Q. at Maymyo and 1 Burma Div. coming down from the South Shan States to the Toungoo-Pui area north of the break across the rail and road. We had orders to be ready to move at one hour's notice, probably next morning—had said good-bye to all Embarkation staffs who had left two days before while my embarkation pair with their staffs had gone off to Prome.

Then the picture changed. A convoy of 9 ships was expected to come through what was virtually our front line. Back came the embarkation staff! I was lucky in catching our medical embarkation personnel by phone at Prome; back they came and opened up again in Sale Barracks and we prepared to receive a new Brigade.

We seemed so completely out of touch with the medical units at Prome and farther north that I felt I must get up to Prome to see how things were. I left Lane as liaison officer with Adv. H.Q. and Coppinger as Staff Captain. I saw all medical units with 17 Div., Dalziel with his 13 Lt. Field Ambulance and the sections of 8 C.C.S. at Tharrawaddy; and 2 Bur. G.H. at Prome. I saw 8 C.C.S. on H.S. "Mysore" and arranged with the Irrawaddy Flotilla Coy. for two more hospital ships, "Kalaw" and "Fano." Missing de Souzaz (A.D.M.S., L. of C.) I went up to Maymyo. Here I found so much to do that I could not get away for four days. In the meantime the balloon had gone up at Rangoon. The demolition was done. Adv. H.Q. with 17 Div. and the new Brigade were trapped by the Japanese road block on the twenty-seventh mile of the Prome road and had to make that fine attack and break-through. I am afraid I left a good deal on Lane's shoulders at that time.

However it was just as well that I had come up. I saw all the medical units on the way and there were many things to fix up at this end. I found, amongst other things, that H.Q., L. of C. was ensconced in Maymyo with de Souza, A.D.M.S., out of touch with nothing to do. I ordered him to make his own H.Q. at Mandalay and work from there. 41 I.G.H. were told to open up to their 1,000 beds. 3 Bur. G.H. opened up in the High School 8 Burma G.H., Oppenheimer in Command, was given G and Q sections and encouraged to expand up to 200 British beds. 60 Indian G.H. was to expand to 400 and then to 600 beds. The reception of Hospital Ships at Mandalay and removal of cases by Nos. 1 and 2 Ambulance Trains was arranged with de Souza. As soon as I saw how things were going at Prome I came back north, calling at Magwe about the evacuation of invalids and fixing up for 2 B.S.S. to take the patients.

Then I took the chance of going East into the Shan States to see No. 1 Burma G.H. at Kalaw and to No. 4 Burma G.H. at Taunggyi. They had had no letters for ten days and had heard nothing of their probable move to Shevebo. From there I went across to Myingyan where I had intended putting two I.G.H.s and 2 Convalescent Depots. It is a poor-looking place and the approach to the river.

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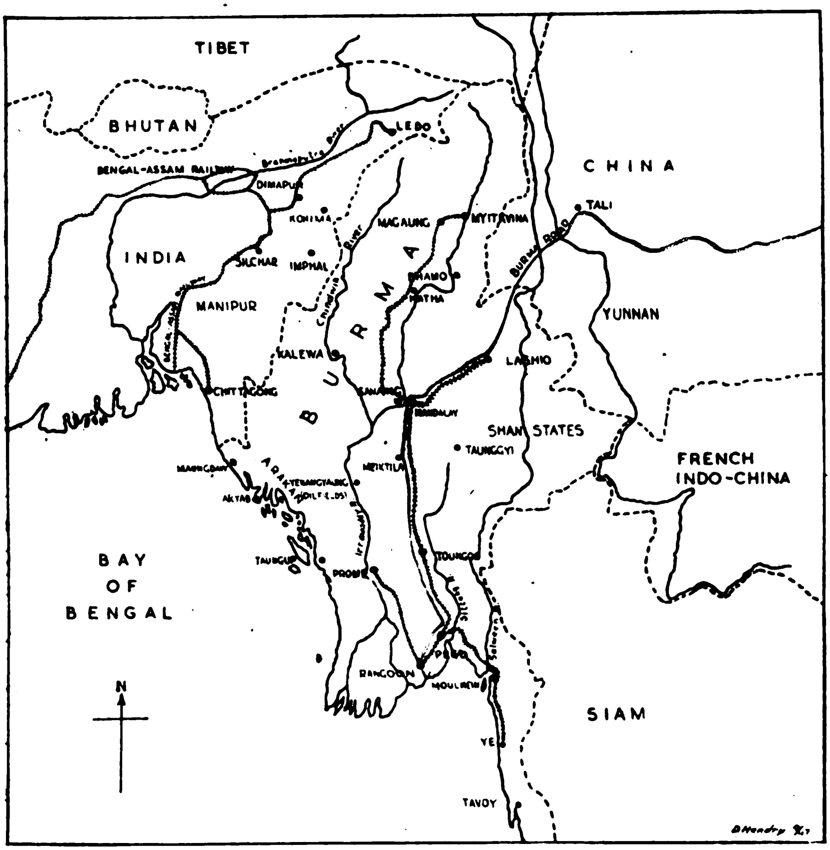
which on the map was one of the advantages, is by a sandy, rutty lane, four miles long and impassable for ambulance cars. 59 Indian G.H. is there with 1 officer, 12 O.R.s and nearly all their equipment. The hospital had been originally sited at Pegu and all their kit had been dumped there. Captain Singh Rao had, by great enterprise and the persuasion of his pistol, collected labour and transport and saved the bulk of the equipment in the critical days before the line was cut at Pegu and had managed to get it on trucks on the railway and so to Myingyan. This was a really fine piece of work.

After this I came back here where life consists of making up combinations of our available medical units to fit the permutations of the G plan for the disposal of the fighting troops. I definitely should stay here in order to supervise and give decisions. But, after arriving late on Sunday evening, I got word on Monday to meet Jolly at Lashio on Wednesday. So off I went, with Preston, this time to Lashio. There on the evening of the 17th I happened to see Captain McIver on his way to the Military Mission at Chungking.



Jolly (General Jolly, D.G., I.M.S.) arrived on the 18th and yesterday we all came back here and have been conferring on the medical needs, civil and military, of the Kalewa Road. Also he has explained the medical needs of the Chinese Forces. General Lee, the D.G. of the Chinese Medical Services and

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General Lim, Director of the Chinese Red Cross, are arriving in three days' time. I propose to take them down to see the back areas of their forces and do what we can to help them. Jolly will explain all this part to you.

DATED MARCH 21, 1942.

I am afraid this has been a very rambling account and has only taken in my own point of view. There are one or two more points.

Nursing Staff.—Nursing orderlies are so poor and difficult to get that I am taking every trained man that I can get. Unfortunately this "flap" and evacuation order had got going first and many have gone. However, we are nearly up to our authorized quota. I have every intention of going beyond it if I can get the numbers. The real difficulty is messing accommodation. Cooks, bhistis, sweepers are fast disappearing.

Can I have back the 7 Q.A.s who were evacuated on the "Neuralia"? Above all I want a Principal Matron to look after them. Can Miss Hughes be sent in soon?

On the whole, medically, things are not at all bad. The standard of nursing and hospital accommodation may be a bit low, but we should be able to make-do very well on the men and material you have sent, or will send. Sick rates are low at present but, of course, this is the healthy season and dysentery and malaria are yet to come. Casualties I have not yet been able to total up because returns take such a time to come in. It is worth mentioning road accidents. These have been past belief and many hospitals consider that road accidents exceed by far the number of battle casualties.

Our main needs at present are:—

Personnel for 59 Indian G.H. I have a suitable C.O. but cannot raise the staff.

Convalescent Depot Staffs: We have none and I am bringing 2 B.S.S. up from Magwe to Maymyo to form a British Convalescent Depot here. Our beds are being cluttered up with convalescent patients.

Ambulance cars: These will be impossible until the road opens. We have, and are acquiring, a good many or substitutes. I suspect we have a good many more than we should have. To conserve petrol, hospitals are using bullock- and horse-drawn vehicles of any kind available for station duties.

We have a considerable number of outstanding indents, fulfilment of which, I am told, would satisfy our needs for a good long time. Pyrethrum extract, citronella, hand-spray guns and quinine will be some of our greatest needs.

Thanks to you and all the others for what you have done. We are in good fettle and will jolly well carry on, decently, I hope, whatever happens.

PS.—One thing stands out a mile. Field ambulances need to have much less equipment normally, and should be *completely* self-mobile.

All medical units should have some form of transport on their W.E. Transport for O.C. for communications, for ration drawing and collection of stores, and some for personnel. Every unit of every kind needs this. It is *impossible* to get transport from any pool or G., P.T. Coy. when really needed. This is at the bottom of the cause of much loss of equipment in this show.

[*To be continued.*]

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DISPOSAL OF THE SICK AND WOUNDED OF THE ENGLISH ARMY DURING THE SIXTEENTH CENTURY.

BY

DAVID STEWART.

IN the sixteenth century important changes were made in the methods of disposing of the sick and wounded of the English Army. In earlier times there had been no machinery for dealing with men when they became casualties, and it was not considered that the authorities had any responsibility for their welfare or for assisting in their recovery. If it was thought that incapacitated men would not be ready for service again within a short period, it was the custom to discharge them, and the Army lost all interest in them. If they were fit to travel they made their own way home, if not, they were left to the care of the civil population of the neighbourhood; and there they either recovered or died.

This system was bad enough during wars within the boundaries of the island of Britain, but in continental wars it must have inflicted indescribable hardships upon the sick or wounded soldiers. What must have been the feelings of these poor fellows, abandoned somewhere in France among an alien people, speaking an unknown language, and openly hostile to them? They were not only far from their home, but they were separated from it by a very formidable obstacle, the sea.

Occasionally, however, the authorities realized the hardships that the men underwent under such a system. Edward III, in 1346, evacuated a large number of his sick and wounded to England (Oman, p. 132): and the same thing was done in 1415, after the capture of Harfleur, when the numerous victims of dysentery were allowed to return home (J.A.H.R.S., p. 168). This, however, was the only modification made in the normal routine: after the men had landed at the home ports, the authorities were finished with them, the Government felt that it was under no further obligation to them, and they had to make their own way to their homes as best they could.

It has frequently been asserted that the seriously wounded were disposed of in an even simpler manner, in a way that would cause neither trouble nor expense to the higher command: that is to say, their throats were cut. It has been stated that the dagger called the misericorde was so named because it was used for putting the wounded out of their misery. Scott (i, p. 184), however, suggests that this may be incorrect, and that the misericorde got its name from the cries for quarter from a wounded man when he saw his enemy advancing with this weapon in hand, ready to finish him off. There may have been isolated instances of commanders ordering the slaughter of their wounded, but these must have been extremely rare. That it was the usual practice, even in the Middle

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Ages, is more than improbable. It is not even a custom among the wildest and most primitive peoples; they may slaughter their wounded enemies—after all Henry V did this at Agincourt—but they take the greatest care to see that their own wounded do not fall into the hands of their opponents, and even in defeat make every effort to carry away their incapacitated comrades.

If the matter be considered seriously, it must be realized that the morale of no Army would have stood up to such treatment. Life means a great deal to any man, and if a soldier knew that the result of being more than slightly wounded would mean that his throat would be cut, then he would take every precaution to see that he was not wounded, and this would have seriously diminished his value as a soldier. It is true that, at this period, the chances of a man recovering from a serious wound were not good; the percentage of deaths under surgical treatment was very high; nevertheless some did recover; and as life is sweet, the average man, when he was wounded, must have hoped that he would be one of the lucky ones. Actually, we know that some care was taken of the wounded during an engagement. At the Battle of Poictiers, at one stage of the fight, the French made a vigorous attack and nearly won the day, because they caught the English busily employed in getting their wounded out of the fighting line to the rear (Oman, p. 173).

In the first part of the sixteenth century little improvement was made in the methods of disposing of the sick and wounded. Of the earlier, and rather farcical, wars of the reign of Henry VIII there is little or no information, but in the campaign of 1544 the wounded were dumped in England much in the same way as had been done during the reign of Henry V. There was, however, one important difference; an attempt was made to prevent fit men from getting away on the excuse of being sick (S.P.H. viii, p. 114). This does not appear to have been very successful as there were bitter complaints from the Privy Council to the Duke of Norfolk, that large numbers of men, perfectly fit for service, were being shipped over to England. The King went so far as to accuse Norfolk of doing this deliberately, so as to render his force unfit for further service, and thereby to make it necessary to recall him (L.P.H. viii, p. 224).

Norfolk and his colleagues repudiated this charge most strenuously (*ibid.*, p. 235) but there is evidence to suggest that Henry's suspicions were not ill-founded. After the failure of the siege of Montreuil, Norfolk had retired to Calais, and continued to stay there, although he was urged from home to march to the relief of Boulogne, which at that time was besieged by the Dauphin. It was while the troops were at Calais that the immense exodus of the sick and others took place. One cannot blame the unfortunate troops, there had been a severe outbreak of dysentery, soldiers were literally dying in the streets, and naturally the men took the first opportunity of escaping from these horrors. Norfolk realized all this, and felt that something had to be done to check the wastage; he therefore appointed a small committee consisting of Sir George Carowe, and Messrs. Baynton, Harper, and Ryche to superintend the evacuation, and to see that none but the truly sick were allowed to depart for England

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(*ibid.*, p. 235). These gentlemen were not medical men, and it is difficult to see how they could have been expected to carry out their difficult task efficiently, indeed Norfolk acknowledges that they did not do so, and that a number of malingerers slipped through their hands to get away to England. The whole business seems rather dubious, and one wonders if the committee were really expected by the commander in chief to do their work efficiently, or were merely appointed as a blind, in order that Norfolk could pretend that he had taken all possible steps to prevent fit men from deserting the colours, at the same time putting no real obstacles in their path. In this way he hoped that his Army might be so diminished in numbers that his recall would become imperative. However, whatever may have been the reasons for the formation of this committee, for the first time a body was set up to control and direct the evacuation of the sick and wounded, and this in itself was a marked improvement on what had happened before. But nothing appears to have been done for the sick when they arrived in England, presumably, as in the past, they made their own way home, and the Government felt that it had no further responsibility for them.

Incidentally, it must be noted that the French managed to capture one of the ships carrying some of the sick men, and this will not be the last time that we shall have to record such an action by the ancient enemy.

During the dreadful siege of Havre in 1563, many of the sick from the plague-stricken garrison were discharged, and sent over to England. Towards the end of the siege things were arranged more systematically than at the beginning. Sir Francis Knollys was sent over to the town to inform the G.O.C. that he could discharge all the men who were undoubtedly sick, or who were so seriously wounded that they would not recover within a short period. So that their discharge might not be held up from a shortage of money with which to pay them, they were given tickets signed by the local treasurer and controller, and they would be given their pay on presenting these on their return to England (C.S.P.F., 1563, p. 401). This again was an improvement on what had happened in the past.

When the garrison was allowed to return to England after the surrender of the town, the sick and wounded were carefully looked after at the port of disembarkation. The last detachment arrived at Portsmouth on August 6, 1563, and here the troops were mustered and discharged, except for the sick, who were retained until their condition had improved sufficiently to allow of their being sent to their homes (Salisbury, i, p. 277). They were accommodated in Porchester Castle, and some of them were still there on September 8, but their numbers were now decreasing daily (*ibid.*, p. 282). It is interesting to observe that history repeated itself ninety years later, and in 1658 a proposal was made to use Porchester Castle to house naval casualties (C.S.P.D., 1652-3, pp. 235-6).

During the wars in the Low Countries, the methods employed for disposing of casualties shows little improvement over those in force in previous wars. Sir John Smith complains that the sick soldiers, who were brought to England in

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1584, were in a disgraceful condition, and many of them died after their arrival in this country (Scott, ii, pp. 368-9). Three years later there were complaints from Flushing of the miserable state of the sick in that town. Men had been discharged from the Army, and sent there to await shipping for England, without any money. If it had not been for the charity of the governor who, at his own expense, supplied them with food and drink, large numbers of them must have perished (C.S.P.F., 1587, p. 368). A year later, in 1588, things were no better, and on this occasion the situation was only saved by a collection in the local church. It was recommended that captains should not be allowed to discharge sick men from their companies, nor stop their pay, until shipping was available to take them to England (C.S.P.F., July-December, 1588, p. 345). From what we know of them there cannot be the slightest doubt that the captains of that period would take the first opportunity of getting rid of the sick of their companies as, by doing this, they would be able to put money into their own pockets. They would discharge the sick men, but would continue to show their names on the company rolls, and would draw the pay of the absentees for their own benefit.

Possibly on account of these complaints, the Privy Council began to take an interest in the disposal of the sick and wounded. In 1589 an English Army had been sent to France under the command of Lord Willoughby to assist King Henry IV. However by the end of the year it became very sickly and the French King agreed to its being returned to England. The Privy Council took a hand in the evacuation, and sent Captain Ward over to Cherbourg in command of two of Her Majesty's ships to superintend this operation. They gave him orders to hire a sufficient tonnage of merchant shipping to accommodate the bulk of the troops, while the remainder were to be brought back in the two royal vessels. He was particularly warned to see that the sick were placed in the hired transports, and that he should put no man suffering from infectious disease aboard the two ships of the Royal Navy, lest they might contaminate these vessels (A.P.C., 1589-90, p. 303). At the same time they arranged to send money over to France to enable Willoughby to issue a portion of their pay to his men (*ibid.*, pp. 291-2). Although the Privy Council appears to have been less interested in the welfare of the sick than in the cleanliness of Her Majesty's ships, they at least did make arrangements for the soldiers to have some money, and, as we shall see later, they made preparations for the reception of the sick and wounded on their arrival in this country.

The schemes of the Privy Council however went astray, because Willoughby had already made his own plans, and had begun to evacuate the sick and wounded to Rye before he received the instructions of the Privy Council. As soon as that body received this information, they issued orders to the Mayor of Rye to take charge of the sick when they arrived; to see that they were properly looked after; to pay each of them ten shillings; to get them billets; to arrange for their rations; and, when they should be fit to travel, to issue passes to them to enable them to get to their homes (*ibid.*, 308-9).

These instructions were faithfully fulfilled by the Mayor of Rye. Some 80

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odd sick soldiers were sent to that town and judging by his report, the local authorities dealt with the situation very competently:—

The Mayor and Jurats of Rye to Sir Francis Walsingham. Rye, 5 Feb., 1590.

"The diseased soldiers . . . rested upon the town's charge eight days in most miserable sort, full of infirmities in their bodies, wonderfully sick and weak, some wounded, some their toes and feet rotting off and lame, the skin and flesh of their feet torn away with continual marching, all of them without money, without apparel to cover their nakedness, all of them full of vermin, which (no doubt) would have devoured them in very short time if we had no given them most speedy supply. Whereby we were constrained to wash their bodies in sweet waters, to take from them all their clothes and strip them into new apparel, both shirts, petticoats, jerkins, breeches and hose, made of purpose for them. Then we appointed them several houses for their diet, and keepers to watch and attend them, and also surgeons to cure their wounds and rottenness; by this means we have saved some forty-eight of them, which will be able to do Her Majesty good service. . . . And this has been to the town of Rye so great a burden as we are not able to bear. And that now happeneth amongst us is much to our grief (God of His mercy stay in His good time), for the persons in whose houses they were lodged and dieted, and the women that did attend and watch them are for the most part fallen very sick, and every day there dieth four or five of them with the infection which they had from the soldiers.

We therefor humbly pray that the burden of this great charge, performed from charity and duty to God and Her Majesty, may not lie upon us, which charge, as appears by the book herewith sent, amounts to the sum of £55 11s. 3d.; besides the charge of the soldiers that remain in Rye, which will be above 50s. every day." (Ancaster p. 305.)

This letter from the Mayor of Rye and his colleagues has been given in full, because it gives such a vivid picture of the means available at that time for caring for the sick and wounded, and of the risks which a town ran when infected soldiers were placed in its midst. One feels that it will be generally agreed that the authorities of the town of Rye carried out their difficult task in a most admirable manner. The steps, which they took to cleanse the men and issue them with fresh clothing, were the best available at that period for the prevention of the spread of the disease (presumably typhus) to the civil population. It can only be regretted that they were unsuccessful in achieving this objective; and it is to be hoped that they were duly recompensed by the Government for their expense and trouble. But, judging by the experience of other towns at a later date, it is probable that they had to wait a long time for their money.

During the campaign in France in 1591, a further improvement was made in the methods of evacuating the sick and wounded from the Continent to England. The responsibility for supervising this work was put into the hands of a special officer, Sir Henry Killigrew, who was posted to Dieppe for this purpose. He found his task a difficult one, and as early as September 22, he is complaining of the difficulty of preventing men from slipping off to England on their own account. He maintains that there is no excuse for this conduct, as everything possible is done for their welfare at Dieppe (Salisbury, iv., p. 127). The evacuation of the sick was quite a large undertaking, and by the end of October some

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1,700 of them had been shipped back to the home country (*ibid.*, p. 155). About this period there was a hold-up in the evacuation on account of contrary winds, and some of the men on board the transports were suffering from a shortage of rations and money. The former shortage was due to the fact that the governor of the town was a Frenchman, who could not issue rations to English troops without orders from his superior officers, and Killigrew promptly wrote to the Earl of Essex asking for such orders to be issued. Killigrew considered that the shortage of money could be due only to one of two causes. Either the company commanders had never issued it to the men, or, as he thought was more probable, the men had had it and spent it before they arrived at Dieppe (*ibid.*, pp. 157-8). From what we know of the captains of those days, it is probable that Killigrew was wrong in his suggestion, and it is more than likely that the company commanders had not issued any pay to these invalids, and as soon as they had got rid of them, had pocketed the money themselves.

Killigrew throws an interesting sidelight on the methods of financing these evacuations, when he mentions that he has had to go to the expense of hiring a ship himself to take the last batch of 200 invalids. He asks, on the ruling of the Lord Treasurer, that this money may be refunded to him by the company commanders; in other words, from the pay of the men themselves. At this time, and for the next two hundred years, the financial authorities acted on the principle that all the expenses of the soldier should be met from his pay. It was from this doctrine that the evil system of stoppages came into existence.

The fact that the sick were short of money evidently came to the notice of the Privy Council, for that august body issued an order to the effect, that if it seemed likely that a sick man would be ill for a lengthy period, he was to be paid up to date by his company, and sent home with a special pass showing which part of the country he came from, and to which Company in the Army he belonged (A.P.C., 1592, p. 101). The Privy Council knew their company commanders better than Killigrew did, and realized that the cause of the shortage of money was due to neglect by the men's captains.

Although the machinery of evacuation was primitive and moved with difficulty, nevertheless it moved, and a distinct advance had been made in the transportation of sick from the Continent; and the Government realized that they had a responsibility for the sick, and that it was its duty to get them home to England. On this side of the water improvements had also been made. It was not now thought to be sufficient to pay a man up, and to tell him that he was free to make his own way home, without considering whether he was fit to do so or not. Now before he was discharged it was somebody's duty to ascertain he was fit enough to travel and, if not, to take steps to get him so before he was sent away.

A further instance of this comes from Gosport in September 1593. On account of contrary winds a batch of eighty-eight sick men were landed unexpectedly at that town. Instead of being packed off home straight away, they were allowed to rest for two days at Gosport, and received pay during that period. Two died, and seventy-seven of the remainder were then given travelling

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money, calculated on the basis that they would only be able to walk eight miles a day. The remaining nine men were retained at Gosport until they had recovered from their illnesses (C.S.P.D., 1591-4, p. 374).

Furthermore it had come to be realized, before the end of the century, that the community was under an obligation to those soldiers who had been incapacitated in the service of their country. Means were taken for their relief, but this is too large a subject to be taken up here, and must be left to some future date.

From now onwards it was the established practice to evacuate the sick from the theatre of war to the home base. In the French campaign of 1597, on account of the loss of Amiens, some of the English troops had to move in a hurry (Salisbury, vii, p. 102). They had to abandon their baggage and some of their sick; nevertheless, a large number of the sick were got away and evacuated to England. On this occasion it fell to the lot of Dover to look after most of them. The authorities of that town were put to a good deal of expense in caring for those who were unable to travel, in issuing money to those who could, and in burying those who died. They wrote to Cecil, asking him to reimburse them for these charges, and at the same time urged him to send them a supply of corn which had become scarce on account of the influx of the troops (*ibid.*, p. 157).

In Ireland the same procedure was carried out, as various references in the Calendars of State Papers show. However, in 1599, it occurred to certain people that this was not an economical policy. Large numbers of men were sent back to England, who never returned to Ireland. Their places were taken by drafts of new and unseasoned men, who were not innured to the climate and conditions under which they had to live in that country, with indifferent food and poor lodgings. As a result they went sick in large numbers from the country disease —dysentery—and they, in their turn, were also evacuated to England; and so the vicious cycle went on. Why not stop all this, and institute Guest Houses or Hospitals, such as were to be found in Holland, where the sick could be looked after and nursed back to health? If this were done, the men, after their recovery, would be of three times the value to the Army than they had been before. They would have established an immunity to the prevailing disease, and would more easily become inured to the hardships that they would have to endure in such a primitive country. In this way the sick-rate would be brought down to a reasonable level; the Army would be kept up to strength: the Queen would be saved the expense of hiring transport for the evacuation of the sick, and also the cost of having to supply large numbers of new soldiers every year to take the place of those who had died, or had been invalided (C.S.P.I., 1599-60, pp. 334 and 350). To show how great this wastage was, it was generally accepted that any body of troops, six months after landing in Ireland, lost about 50 per cent of its strength. Although a certain proportion of this loss was due to men slipping back to England, or even deserting to the Irish, the greater part of the wastage could only be accounted for by death and disease.

Once the question of establishing hospitals was raised, it was given the most serious consideration, and at the highest level. In the Calendars of the Irish State Papers and the Carew Papers there are a number of papers bearing on this

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subject. It is, however, interesting to note that even earlier than this, in 1598, some of the leading citizens of Dublin proposed founding a military hospital in that city. At a cost of £1,000 a year they proposed to establish a hospital of fifty beds, which, according to the practice of the period, would accommodate a hundred patients. A staff of half a dozen nurses and a surgeon were also to be provided (Cruickshank, p. 124). Nothing came of this scheme, and it was only when the matter was taken up by the Privy Council that anything concrete was decided upon. Lord Buckhurst proposed that a hospital should be provided in Ireland, fully equipped with everything necessary for the treatment of the sick and wounded (C.S.P.I., 1590-60, p. 377). Lord Mountjoy, the Lord Deputy elect, went into greater details, and recommended that hospitals should be established at Cork, Dublin, and Drogheda. Each of these hospitals should be under the supervision of two unpaid overseers, "Honest householders of the town." The stipendiary staff was to consist of a Master at five shillings *per diem,* his servant at twelve-pence, and four women at sixpence apiece. The masters were to be either surgeons or physicians, and the hospitals were each to be provided with one hundred beds—presumably for two hundred patients (*ibid.,* p. 448).

As a result of these discussions the Lord Deputy was instructed to erect four hospitals in Ireland (C.C.P., pp. 358-60). Whether all of these were established is uncertain, but a warrant was issued to certain aldermen of Dublin on May 28, 1600, to form a hospital in that city (C.S.P.I., 1600, p. 209), and in October of the same year there is a reference to certain hospitals being in existence in Ireland (*ibid.,* p. 505).

About one of these hospitals a good deal of information is available. This was the one established at Derry, for the sick of the force operating in that area, under the command of Sir Henry Docwra. On the motion of Lord Buckhurst, at a meeting at Richmond at which Docwra was present, it was decided that Sir Henry should be instructed to establish a hospital at Lough Foyle (C.S.P.I., 1599-1600, p. 393). In March the Lord Deputy and his council issued a formal order to Docwra to build this hospital, with materials sent from England for that purpose (C.C.P., p. 375).

The institution of the hospital at Lough Foyle was a very wise move, as the men of that force fell sick in very large numbers. Unfortunately Docwra did not carry out his instructions as fully as he should have done, and only provided a unit of twenty-eight instead of a hundred beds, as had been ordered. His excuse for this omission was that, first he could not get the men to work, and secondly that he had not sufficient material to build a larger structure. It is possible that the general corruption of the times had something to do with it: and it may be that Docwra put money into his own pocket through this transaction. Be that as it may, the above were the excuses offered by Docwra when criticized for not providing a hospital of sufficient size to accommodate the large numbers that fell sick, in the force under his command (C.S.P.I., 1600, p. 406).

The evidence brought forward in this paper shows that important advances were made in the organization of the disposal of the sick and wounded during this century. The evacuation of casualties was controlled by the central authori-

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BY

Colonel F. RICHARDSON, *D.S.O.*

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Travelling through Europe in a civilian train sent me mentally back to pre-war holiday journeys, and I found myself looking anxiously at the rack for my skis, and being rather surprised to see myself in uniform. It was indeed hard to remember that we were on duty—bearers of the British balneological banner.

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The proceedings of the Congress were in Czechoslovakian, French, and English, and the number of countries which preferred to use English surprised us. Delegates had come from countries as far apart as Peru and Turkey, but it was disappointing that the Russian delegates did not come as we understood that much recent research into spa treatment has been carried out in Russia. I was in some doubt of the existence of some of the countries which had sent delegates, but this was not surprising since, at the opening session, we wandered

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Two of us were full Colonels but any hope of cutting a dash in the glory of our dull cherry was dispelled by our first sight of the Czech police who wear a uniform like that of a full Colonel R.A.M.C. in Service dress, only much smarter. I remembered pre-war days when the waiters in MacBrayne's West Highland boats wore R.A.M.C. mess kit. In Czechoslovakia our uniform gained for us not tips under the plate, but many obsequious salutes obviously designed to placate some unknown god in the higher police theocracy.

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Unfortunately, Dr. Donald Wilson of Bath, who would have been the main representative of our country, did not turn up, and we felt somewhat lacking in knowledge of the subjects under discussion. We were occasionally asked which British spa we represented, and it is perhaps a pity that we represented none of these as our lean figures would have been a good advertisement in contrast with those of some of our continental colleagues, some of whom would have justified a claim for the congress to that adjective often used in connexion with such international conferences—"broad based."

This is not the place for a discussion of the lessons learned from the Congress. These will be written up by the junior delegate, who represented the Consultant Physician B.A.O.R., and kept Great Britain on the map with a brief but well-timed and very well-received comment, in which sound common sense and humour were judiciously blended. Apart from this and one appeal for observance of an old English principle of climato-therapy, an open window, our role was that of interested observers.

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much about the food, since we seemed to be given at each of two, and sometimes at three, meals a day as much meat as an Englishman now gets in a week.

Lest our spirits should flag on a train or bus journey, slices of bread thickly spread with butter and loaded with ham, tongue, salami, eggs, and caviare, and trays of assorted fruit, were pressed on us at short halts. At formal lunches or dinners it was the custom to serve vermouth, beer, white wine, and red wine in that order, with the meal, the red wine being sometimes omitted.

To us the inclusion of beer in such a programme of drinks is a little unusual, but it was a very pleasant habit and seemed to help to wash down the great quantities of food which we were given.

I never discovered the exact significance of the two tails worn by the Czechoslovakian heraldic lion, but it is possible that they indicate reduplication of its alimentary canal.

It is a little difficult for us whose stay in the country was made so easy and comfortable by the generous hospitality of the Czechoslovak Government to estimate how easy a visit would be for ordinary tourists, but we can say that it is a country which would richly repay any trouble which arranging the visit might cause; and, as they must want plenty of tourists to replace the Germans who used to visit them before the war, difficulties and expense are not likely to be too great.

I am sure that no one who has spent a few hours in Prague could fail to want to go back and to explore thoroughly that wonderful city. The English always seem to have an undying enthusiasm for visiting cathedrals, a form of tourism to which I am rather allergic. In future when I am invited to look at a cathedral I shall be able to reply "No thank you. I have seen the cathedral at Prague."

Finally I must record that the invitation to delegates included their wives, a kindness of which only I amongst the British delegates was able to take advantage; and that my companions—it is still a little difficult to realize that they were not really truly balneologists, or hydroclimatologists to use the term agreed upon by the Congress—were Colonel W. M. Oxley and Lieutenant M. B. Matthews.

Notices.

A TWO MONTHS' POST-GRADUATE COURSE IN SURGERY

will be held at the Royal College of Surgeons in Ireland, starting on April 12, 1948. The number of students is limited to 30. The fee is 20 guineas. Students may enrol now with the Registrar, Royal College of Surgeons, St. Stephen's Green, Dublin.

CHANGE OF ADDRESS.—Burroughs Wellcome & Co. announce that, from *Monday, December* 15, the address of their Home Division will be 183-193, Euston Road, London, N.W.1 (Telephone EUSton 4477). The same address will apply to their Overseas Division from *Monday, December* 21. Practitioners are asked to send communications to this address in future.

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Reviews.

MALARIA. With Special Reference to the African Forms. By W. K. Blackie, M.D., Ph.D., F.R.C.P.Ed., D.T.M.&H. 1947. Capetown: for the Post-graduate Press by the "African Bookman." Pp. 104. Price 10s. 6d.

This short work gives a concise account of malaria, but excludes discussion on measures of control except for a brief description of chemoprophylaxis. A study of its pages is productive of a comprehensive picture including the natural history of the disease and the part played by immunity, to which much is contributed by the short pictures drawn of malaria in the African. The exclusion of blackwater fever limits the value of the publication. Its main merit is its simplicity and clearness in the presentation of the subject matter it covers.

PRACTICAL POINTS IN PENICILLIN TREATMENT. Second Edition. By G. E. Beaumont, D.M.Oxon, F.R.C.P.Lond., and K. N. V. Palmer, M.B.Cantab., M.R.C.P.Lond. London: J. & A. Churchill, Ltd. 1947. Pp. 18. Price 1s. 6d.

This small book contains a useful short summary of the method and scope of penicillin therapy for general practitioners who have not had the opportunity of studying the administration of penicillin in hospital. While it serves this excellent purpose well, not all will agree with some of the courses of treatment formulated by its authors. Experience in the Army fails to support a recommendation for the treatment of typhoid fever with penicillin and sulphathiazole. Many also would doubt whether advantage is gained by raising the total dosage employed in the treatment of syphilis to the nine to ten million units suggested by the writers. These, however, are details which only further experience will finally elucidate, and as an interim guide the book is well worthy of the place it fills in the literature on penicillin.

MODERN TREATMENT YEAR BOOK 1947. Edited by Sir Cecil Wakeley, *K.B.E., C.B.*, D.Sc., F.R.C.S., F.R.S.E., F.A.C.S., F.R.A.C.S. (Hon.). London: The Medical Press. Pp. 354. Price 15s.

This book now in its twelfth year of publication aims at giving the General Practitioner, with scanty leisure for any form of post-graduate study, a clear and practical account of modern diagnostic and therapeutic methods.

Forty-four subjects taken from all branches of medical and surgical practice are discussed, and in many instances further references are given. Viewed individually the volume appears to present a random selection of subject matter, but those for whom it is intended will not fail to find it well representative of their everyday needs. It provides an excellent cross-section of the practice of modern medicine and surgery in which new and time-honoured methods of treatment and the practical application of accessory methods of investigation are clearly and simply set forth.

J. B.

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ESSENTIALS OF CLINICAL PROCTOLOGY. By Manuel G. Spiesman, B.S., M.D. Published by Wm. Heinemann, Medical Books Ltd. Price 21s. net.

This book sets out to cover the essentials of proctology, including aids to diagnosis. The author gives those methods of diagnosis and therapeutics which he has found most helpful in his practice, and the surgical measures described are often those which could be practised in the office. It is perhaps surprising to find the technique of the Wredin-Stone operation for anal incontinence described.

Minor rectal conditions are usually the cause of much suffering and unless well treated cause much disability, and, while this book is uneven, it contains material which will be of value to student and practitioner. D. C. B.

THE TREATMENT OF RHEUMATISM IN GENERAL PRACTICE. Fourth Edition. By W. S. C. Copeman, *O.B.E.*, M.A., M.D.Cantab., F.R.C.P. London: Edward Arnold and Co. 1946. Pp. 268. Price 12s. 6d.

The author of this work makes no pretence to present a textbook in the academic sense but rather aims at guiding the general practitioner in matters of technique and choice of treatment. Our various resources for combating rheumatic diseases are discussed in a manner which facilitates choice of methods and gives a reasonable assessment of the results which can be achieved by their systematic use. Additional short chapters deal with the particular psychological problems incidental to the doctor-patient relationship in this large field of the practice of medicine in which an attitude of defeatism has been too prevalent in the past, choice of spa and suitable climate, osteopathy and "nature" cures, prognosis and end-results.

The opinions expressed in the book are those of a general physician and their formulation bears the imprint of much careful consideration based on experience. As such their close study should shift the emphasis of methods employed on to those likely to be fruitful in maintaining health and raise the general standard of treatment of the rheumatic diseases.

CURARE. Its History, Nature, and Clinical Use. By A. R. McIntyre, Ph.D., M.D. U.S.A.: University of Chicago Press. U.K. and Ireland: Cambridge University Press. Pp. 240. Price 27s. 6d.

This monograph is a well-documented account of all aspects of curare. From the story of its early witnesses in the field of exploration, its botanical sources and chemistry, the author passes on to a chronological and systematic review of the physiological experiments in which its use has thrown light on the neuromuscular transmission of the impulse to contraction. In his own work d-tubocurarine has been used, and he advances the theory that the drug inhibits the normal role of acetylcholine at its point of action in the muscle. The nerve impulse to muscle acts by increasing the concentration of acetylcholine at the motor end plate. Curarization raises the threshold for contraction above the available concentration of acetylcholine and the muscle fails to respond. Eserine increases the amount of acetylcholine to a level above the heightened threshold

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Protein-replacement therapy

HEPOVITE

COMPOSITION
(Each 30 grammes contains)

"Protein" (N x 6.25)	15 grm
Carbohydrate (Maltose)	11.4 grm
Vitamin A	500 i.u.
Vitamin D	50 i.u.
Aneurine HCl	1.0 mg
Riboflavin	2.0 mg
Nicotinic acid	6.5 mg
Pantothenic acid	11.3 mg
Pyridoxine	0.32 mg
Biotin	0.065 mg
Folic acid	0.05 mg
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and so antagonizes the action of curare. The author tentatively suggests that all physiological processes dependent on acetylcholine are affected by curare to some extent, and that the fall in blood-pressure and immobility of the gut seen during prolonged administration can probably be explained in this way.

.Apart from its use in anæsthesia as an adjuvant in obtaining relaxation and preventing shock, the drug is used extensively in the electro-convulsive treatment of the psychosis for the prevention of injury, and it achieves this without interference with the therapeutic result. Further trials in the treatment of desperate cases of tetanus are suggested by the author with the proviso that artificial means for the maintenance of respiration should be at hand. It is suggested that the drug can be utilized in the diagnosis of mild cases of myasthenia gravis and in the relief of spasm in various conditions including the management of orthopædic cases.

The author makes no claim to have reached finality in the pharmacological action of curare, but his work can be recommended to those who wish to secure a firm foundation for speculative interest in the subject. J. B.

Diseases of the Joints and Rheumatism. By Kenneth Stone, D.M.Oxon, M.R.C.P. London: Wm. Heinemann, Medical Books, Ltd. 1947. Pp. 362. Price 30s.

This book is intended for students and practitioners who regret the omission from the medical curriculum of teaching in the "rheumatic diseases," and it attempts to lay a foundation for a sound knowledge of these. It consists of two parts. In Book I a systematic presentation is given of classification, general anatomy, physiology and pathology of the joints, methods of examination and principles of treatment. After chapters based on disease entities, painful joints in children are described, followed by discussions on morbid conditions of joints on a regional anatomical basis. Brevity and conciseness are achieved over a range which includes historical prefaces to the chapters dealing with disease entities of joints, and, in the case of individual joints, essential anatomical considerations and methods of examination. A chapter on chronic strain of ligaments and the effects of faulty posture will be found of particular interest to military medical officers.

Book II is largely devoted to the thesis that a correlation exists between vagotonia and the common rheumatic "myalgia," a condition clearly differentiated from rheumatic fibrositis, and, while the rather long discussion thereon widens the outlook of the reader on the subject matter and is an admirable attempt at integration, it seems misplaced in a textbook. The evolution of our conception of sciatica into a lesion of the intervertebral disc and the case for the existence of a fibrositic lesion are well presented.

The book is well illustrated and in the field of disorders of locomotion meets many requirements of an Army medical officer which are difficult to find elsewhere. J. B.

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Original Communications.

BURMA RETREAT, 1942—Part II.

(*Compiled from letters written by* (*then*) *Brigadier T. O. Thompson, D.D.M.S., Burma, to* (*then*) *Brigadier H. C. D. Rankin, D.D.M.S., G.H.Q., India.*)

I have been asked to continue my rambling notes about the withdrawal from Burma to complete the picture.

I am afraid these notes will not seem quite so spontaneous, seeing that we have been out a month and events have rather receded into the background. Anyhow, I will have a try to paint a picture which will be useful to others.

Retreats as a rule, win faint praise, but personal experience of two previously and of this one from Burma have convinced me that retreats offer to the Medical Services their most difficult job. It is pleasing to think that the Medical Services have done that job satisfactorily in this retreat.

POSITION IN GENERAL.

Well, at the end of the previous letter we had reached the point where the whole force had turned about face, were cut off from the sea, had no real base or L. of C. leading out of the country and now had the role of defending the Burma Oil Fields and the Burma-China road. The plan envisaged holding a line from west to east south of Prome—Toungoo—the Mawchi Mines to the impassable country along the Salween river.

We had 17 Div. on the right, Bur. Div. down from the Shan States in the centre and the Chinese Armies on the left flank—viz. Toungoo and eastward. There were many plans, one after the other, to each of which we had to devise medical arrangements. One was to form strong points with twenty-one days' supplies at Prome at Allanmyo, a central one and one at Toungoo. For this we were supposed to put in hospital accommodation and medical stores. Fortunately this was not carried through.

What actually came about was a series of attacks, counter-attacks, road blocks and withdrawals which gradually gave up under pressure the Prome area, Prome, Allanmyo, Taungwindgyi, Pyinmana, Toungoo, then finally the oil fields.

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Medical Arrangements.

During this stage we had approximately the following medical arrangements: Four General Hospitals at Maymyo: two at Mandalay; one at Meiktila; two in the Shan States, and two Ambulance Trains.

No. 2 Bur. G.H. was at Prome. Incidentally without my orders this unit put itself on to a ship on the plea of making up a hospital ship. The next thing I knew about it was the C.O. appeared in Mandalay. He was promptly pushed back to the oilfields area with definite instructions not to come away without my orders.

We had five or six ships working to Prome as hospital ships, but it was becoming increasingly difficult to get crews to go down river and often a ship would be left in the lurch at Mandalay by the crew walking ashore.

The H.S. "Mysore" was most useful at this stage as a floating hospital with 8 C.C.S. as staff. In fact the floating hospital has much to recommend it. It was at this stage the Japs definitely gave a signal to the "Mysore" to clear out of a bombing area. A flight of planes circled round at low altitude and attracted attention, then one dropped a bomb about 100 yards away on shore. So the O.C. took it as a message and cleared off upstream for a couple of miles. Six hours later Prome and the area where Mysore had been moored was heavily bombed. It might be worth mentioning that not once have the Japs bombed a hospital area which was clearly marked as such. At Maymyo two "Overs" from the bazaar area hit 3 Bur. G.H., but I am sure they were accidental. At Imphal one bomb hit the laboratory in the civil hospital; again I think an "Over" for the Residency. But this I think is the crux of the matter, *the markings must be plain and large* and the hospitals not near a legitimate target.

The Red Cross must be 75 feet from side to side, viz. each arm 35 feet long and 5 feet wide, placed in a white circle; to be visible from 10,000 feet. It is not the slightest use putting in a fiddling red cross 6 or even 10 feet across: at Maymyo one of our red crosses was the full width of a football ground.

A Medical Store depot was opened at Prome with the stores brought up by the road convoy of Rangoon dust and filth carts.

Cholera was very bad at this stage in the Prome area and we had some difficulty in getting sufficient vaccine down to them.

No. 2 B.S.S. at Magwe held a few patients for air evacuation and Holman as D.A.D.M.S. L. of C. got away some 48, then up to 78 cases by air from the Magwe aerodrome.

Divisional Medical Units.

Bur. Div., with Agate as A.D.M.S., with 2 and 57 Fd. Ambs. came down to the railway area at Pyinmana-Taungdwyndgyi. There were frantic calls from Ingram, A.D.M.S. Bur. Corps, at this time for the hospital train. Three times was this sent down and three times it returned empty, once being ordered away while waiting for patients by the officious A.Q. of Bur. Div. It is an extraordinary thing that any one, from Staff Captains upwards, seems to have a perfect right to order medical units about or to come into a medical unit and criticize its administration whereas a Gunner Unit or Signal Unit would tell such interfering busybodies to mind their own business and tell them to go to ———.

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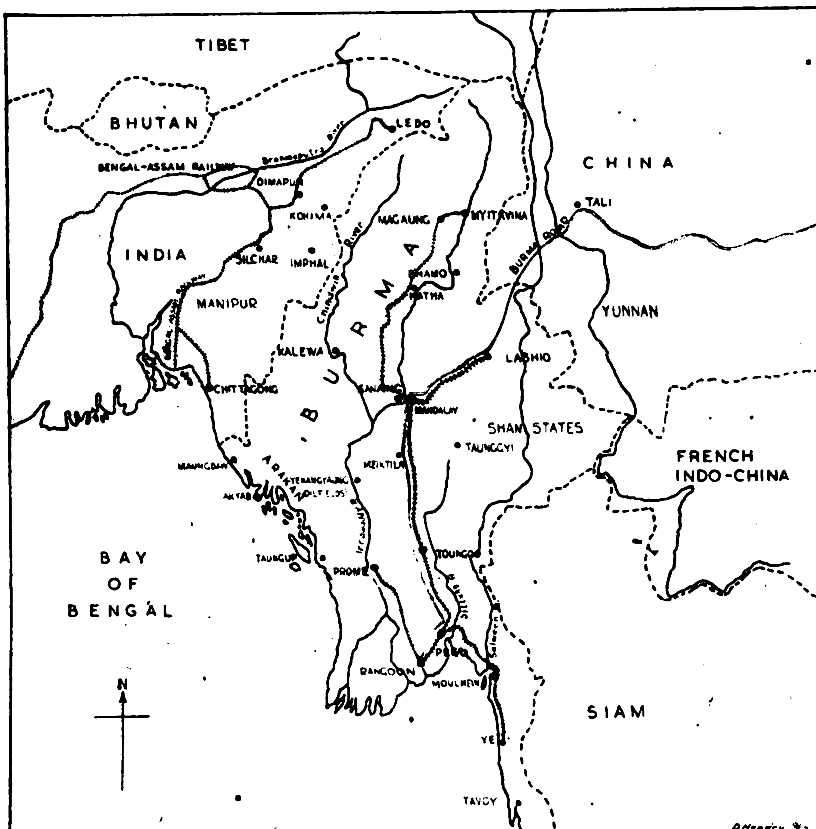
We were also using as a M.D.S. part of the B.O.C. hospital at Yenanyaung. This was a very finely equipped hospital built and run by Dr. Terry and staffed with 2 European and 7 Karen Sisters. It was quite the best hospital in Burma.

Communications.

Communications were very difficult. An Officer Courier System was set going between important headquarters. Even so it was quicker and more certain to send medical couriers. Coppinger, D.A.D.M.S., on his jeep was most useful in this way as he could recce and report at every place.



Moves of Medical Units and Provision for the Chinese.

The river evacuation route was obviously going to become more and more important, so we needed C.C.S.s at various stages on this route. For this purpose 2 C.C.S.s, 4 C.C.S.s and 1 C.C.S. were extracted from the Shan States area, where they had been under Agate and had been treated as Divisional Units. The speed with which they managed to get across to Myingyan, once they received orders, was astounding. Anyhow they were ready before they were expected, and proved most useful. 1 C.C.S. was lent to the Chinese and placed at Meiktila where amidst frequent bombing and loss of personnel, Kingston, the O.C., did exceptionally good work. 2 Bur. S.S. and a small section of 4 Bur. G.H. at Taunggyi

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were also placed at the disposal of the Chinese. Their medical arrangements are very limited: 4 surgeons and 30 trained dressers for an army of 20,000 men. Luckily for them the Friends ambulance unit and Seagrave with his American Medical Mission did wonders for them within their limited scope. The Chinese also had one Amb. train given them by us, prepared for civil defence, but it was split up, a party of officers took one-third of it up the hill and that was that.

General Loo, Chief Surgeon-General of all the Chinese Forces, came to Maymyo. Unfortunately I did not see him there, but I did see General Robert Lim, Surgeon-General of the Chinese Red Cross. It was curious to hear a broad Scots "accent" and idioms from a Chinese General.

Next day Colonel Williams, U.S. Medical Services, Chief Surgeon to General Stilwell's Headquarters to the Chinese Armies, came in to arrange about any help we could give to the Chinese.

Theirs was a thankless task because the Chinese have so little. We gave them all the medical supplies they asked for: arranged for Seagrave's unit to have everything it needed; fixed up about 1 C.C.S. at Meiktila, 2 Bur. S.S. and 4 Bur. G.H. at Taunggyi, the Amb. train and to help out with a hospital ship, the "Assam." We gave them a 100-bedded ward in 41 I.G.H. and were in actual fact treating their patients in nearly every hospital wherever we had contact with them. These arrangements worked well but were very limited considering the numbers of wounded which were coming in. Luckily we had a sprinkling of officers and nurses who could speak Chinese.

It was at this period that a Chinese R.A.M.C. Officer turned up. He had escaped from Shanghai, then from Hong Kong. He had previous war service with the R.A.M.C. and was now again a Lieutenant R.A.M.C. He had lost everything and as his wife and family were in Jap hands he was using a non-family name. I took him on as Major Wan, as liaison officer and finally attached him to our Chief Liaison Officer with the Chinese Forces. He was a stout fellow and did good work.

Medical Arrangements for Withdrawal from Oilfields.

Medical arrangements in the withdrawals under pressure to Prome, from Prome, Allanmyo, Magwe and then the oilfields, were none too easy and Field Ambulances did very fine work in getting cases away. Transport was becoming very short and bullock carts and pack had to be used. MacAlevey, A.D.M.S. 17 Div., was already making his presence felt with fearless shepherding of the Fd. Ambs. and casualties in that Division. The bulk of casualties were got away by river, using the larger ships "Mysore" and "Siam" as floating C.C.S.s and ferrying smaller ships to them or from them up to Mandalay. This journey was becoming shorter, but even now took three to five days and was none the easier from exceptionally low water in the river, desertion of crews, difficulties over rationing and epidemics of cholera at intermediate places.

Shortage of Water.

The dryness of the central areas and the shortage of water caused much hardship to the wounded and there were a number of cases of heat stroke and

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exhaustion. One looked on Burma as being a land of much water and greenery, but the central dry belt is more like the C.P. of India, but even drier with many areas with no water for 30 to 40 miles.

The Battle of Yenangaung.

In the confused fighting round the oilfields medical units had a very difficult time and were frequently under close range mortar fire. In the battle of Yenangaung 57 Fd. Amb., to which I had posted Russell in place of Officer, took it badly and a number were captured. It has been difficult to get to the bottom of the final tale, but report said that Russell was wounded, and a number killed in escaping from a burning building into which they had been pushed as prisoners.

The New Plan.

During this period it was impossible to get down to make personal contact because of the difficulty of being away for more than a day at a time from H.Q.; plans were being changed and, if I went away, something untoward immediately happened. The plan now was that we would hold a line west to east through Chauk-Meiktila—to Shan States, with a three prong L. of C. leading towards India and China, viz. (1) Monywa-Kalewa-Tamu North West to India, (2) Shwebo-Myitkyina North to India and China, (3) Maymyo-Lashio to the Burma-China Road. This meant a complete redistribution of medical units and stores. So the following changes were ordered to be ready by April 15:—

To the Kalewa route: 2 Bur. G.H. Yenanyaung to Monywa with 2 Med. Stores Depot of 200 tons and Fd. Laboratory 2 C.C.S. Myingyan to Monywa and Kalewa. 16 I.S.S. Kalewa and then Tamu.

To the North route: 1 Bur. G.H., Kalaw to Shwebo for holding air-evacuation cases. 13 Depot Med. Stores from Mandalay and 200 tons stores. 4 Bur. G.H. to Myitkyina from Taunggyi. 41 I.G.H. to Katha from Maymyo. 59 I.G.H. tentage and equipment to Katha from Myingyan. 400 tons medical stores from Mandalay. In addition the intention was to form a complete hospital centre from the hospitals at Maymyo at Mounyin, 100 miles south of Myitkyina, where there was a good mission hospital and where it was felt patients could if necessary, be left.

To North-east: 7 Bur. G.H. Maymyo to Bhamo. 3 Fd. Lab. and Medical Stores, Bhamo. B.H.C. H.Q. and training wing, Bhamo. 3 Bur. G.H. Maymyo to Lashio. •200 tons Medical Stores from Mandalay to Lashie.

There were many other minor changes, for example 6 Bur. G.H. having been in the middle of heavy bombing at Meiktila was moved to Sagaign, changed into a V.D. hospital and expanded to 600 beds. Basu in Command at Meiktila had done splendidly in spite of desertions and many other difficulties. He remained as 2nd-in-Command and Eames was extracted from his V.D. wards at 8 Bur. G.H. and put in Command to run 6 Bur. G.H. as a V.D. hospital. He ran an amazingly good show.

2 B.S.S. was put into Hill Bks., Mandalay, as a convalescent Depot and soon had up to 200 patients.

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Medical Units on the Move.

The above is enough to show that the whole Medical Service of the Force was on the move or about to move, the difficulty being to try to retain sufficient beds in use for present needs. We were badly handicapped by having no convalescent depots and very short of British beds. To make matters worse communications became hopeless, and messages to 4 Bur. G.H. at Taunggyi eventually took fourteen days to get there. There was the added difficulty that one never knew whether messages had been received. In addition the railways were being heavily bombed, the line sabotaged or ordinary runnings completely interrupted by Chinese troop movements. Ambulance trains could only be sent with difficulty and when sent were out of all touch until they rolled up with a load of patients.

1 Bur. G.H. had got away through to Shwebo and opened there and some cases were got away by air. Here again there was difficulty because they never knew when a plane was coming or how many would come nor how many patients could be sent.

Eventually 4 Bur. G.H. got away from Taunggyi. Tandon in Command and Miss Fewkes, the Matron, were fine then, and later did magnificent work at Myitkyina. He took one month's rations for his whole staff and patients, an act which eventually proved to be a saving factor at Myitkyina.

I would like here to pay a tribute to "Movement Control" under the command of Colonel Soden. In spite of all these difficulties they managed to produce trains and information as best they could.

Caught on the Hop.

With all these moves going on we were properly caught out when resistance broke and we were pressed back on the right flank and the Jap mechanized force broke through on the East. Cases were pouring into Mandalay by train and hospital ships—300, then 500, then 900, then 1,200 all notified as coming in and the trouble was that the bulk were British cases from the very heavy fighting round the oilfields; a minor item such as 100 cholera cases from a Burma F.F. battalion was nothing.

We were caught with half the hospital closed or on the move; but hospitals, C.C.S.s, Staging Sections and Hospital Ships played up magnificently and all patients were cared for somehow—2 B.S.S. had a mixed crowd of 130 patients. H.S. "Siam" had nearly 500 *mixed* patients; 60 I.G.H. had nearly 700 patients: 41 I.G.H. had over 1,000 British, Indian, Chinese. Burmese and some civilian patients; a group of convalescent officers opened up a convalescent depot in Maymyo on their own: the Padre at Maymyo opened up a Con. Depot for other ranks; 300 beds of a Reinforcement camp were changed to a Con. Depot; 8 Bur. G.H. normally 57 beds + 20 F.M.H. one afternoon had 284 British patients of whom 52 were officers. And so things were managed somehow.

The Visit of the D.M.S. and D.D.H. and P.

To my astonishment they arrived earlier than we thought was possible. They stayed two days and had a thorough view of Maymyo hospitals, bombed Mandalay, Sagaign B.H.C. and the arrangements at Shwebo such as they were.

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The Bombing of Maymyo and Mandalay.

At the former there was not much, only one high level, pattern bombing of the bazaar area. There was ample warning even after the planes appeared and casualties were almost all civilian. Some heavy bombs were used, craters 30 to 36 feet, but the Japs did not obtain their objective of making the civil population bolt; the majority were back in two or three days.

At Mandalay there was no warning, a high wind from the south and much incendiarism by local 5th Columnists. The Japs put down sticks of bombs right across the whole bazaar and on to the station. The civil hospital was badly caught. Surgeons were operating when the theatre was hit, the improvised Chinese hospital was hit and burned. A.R.P. and civilian collection and treatment of casualties was noticeably satisfactory. Civil Medical worked well on this occasion.

It was the raging fire which did the damage and was the amazing thing to see. It was deliberately helped that day and subsequently for ten days by incendiarism. It was somewhat amazing to go and fill up from a petrol pump near the moat with a raging inferno of flames *just across the street*. There was no bombing of the fort area nor any area marked as a hospital area. But the fire in the city passed over the moat, 50 yards wide, and over the fort wall and set fire to 5 Bur. G.H. The old wooden buildings with wooden tiles, oiled year after year, almost exploded as would an open pile of gunpowder. There was some magnificent work done here that day particularly by the Sisters and British and Anglo-Indian orderlies. Miss Briggs, Q.A. (Res.), known to all and sundry as "Blondie,," was outstanding as an example to all. Patients and such equipment as could be saved were moved to the Governor's lodge on the north wall. Moffatt, the A.D.M.S. L. of C. who had recently been commanding this very hospital coolly controlled operations, but had one disconcerting experience. A B.O.R. suddenly came up to him and gave him a clout on the head. "Thanks very much, but what have I done?" said Moffatt. The B.O.R. then asked him to look at his topee; this was smouldering freely with a 4 in. hole already burned through it.

Oppenheimer's achievement in this fire was amazing. He had 600 patients in, and the hospital 60 I.G.H. was seriously threatened by fire. Besides controlling two rescue parties working in the burning city, he moved the whole general hospital—patients, equipment and tentage—to a place of safety near Mandalay Hill in six and a half hours. He and his staff were pretty done at the end of it.

Cholera, Smallpox, Tetanus, Dysentery and Septic Sores.

Cholera was a very serious menace at times. There was such a demand for vaccine that the reserves under Malone at Meiktila and the weekly output could at times not compete. We were lucky and had no real outbreak except one Burma F.F. unit (unprotected) near Myingyan which had some 100 or more cases.

But civil cholera reached epidemic proportions round Prome, at Mandalay, at Monywa and on the Ye-U-Kalewa-Tamu road. We were not impressed with

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the civilian effort at coping with it. In fact, but for work by Vorley, I.C.S., and some others and a private practitioner, Dr. Lusk, cholera at Mandalay would have been a menace. As it was the bombing scattered the population and stopped the epidemic.

Smallpox produced civilian epidemics but hardly affected us.

Tetanus produced some distressing fatal cases. One serjeant had a history of double T.T. immunization. He had been in the jungle, wounded, fourteen days before receiving any hospital treatment.

Dysentery made its presence felt and gave us some serious cases, difficult to manage under the circumstances.

Septic Sores.—These were most noticeable; in fact towards the end of the retreat 1 in 3 of the fit troops had bandages of some kind on them.

Morale, Discipline and Personal Example.

As you can see my opinion of our medical units was that as a whole they were magnificent. I may be inclined to regard many geese as swans, but nevertheless they did their job well and praise gets better results than cursing.

The Standard of Treatment.

The difficulties in maintaining an adequate standard of dieting and treatment were at times great indeed, especially in moving units and on the improvised hospital ships. But considering all things a good standard was maintained and opinion in India appears to approve of the surgical condition of the wounded.

Where patients suffered the most was on the appalling road journeys with no facilities for intermediate treatment. Ye-U to Shwegyn, Kalewa to Tamu, Tamu to Imphal and *above all Imphal to Dimapur.*

Medical Stores—Vaccines-Sera and Laboratories.

Here was one of our greatest successes and eventually our great loss. Saghal had gone off to command 4 C.C.S. and Holman had been brought in to co-ordinate the whole stores bandobast. With his characteristic energy he set to, collected in all over 1,000 tons of medical stores, sorted them out, scrounged transport from the most unlikely sources, got 200 tons of stores off to Lashio. Monywa Shwebo and the bulk of the remainder off towards Myitkyina. In addition he arranged to move the vaccine and sera labs. with all apparatus to Namtu where there were facilities; 3½ tons of cinchona, which the D.P.H. had wisely bought, were being converted in Mandalay Jail to tablets; and he "acquired" the agricultural department's herd of prize cattle to send to Mohnyin to act as a dairy herd for the hospital centre. Of course this soon all came to nothing.

Laboratories—we arranged 4, but these also disappeared.

The Final Crash—Changes of Plan—The General Retreat.

No sooner did it look as though we really were beginning to manage the medical side satisfactorily than the break through of Jap mechanized forces into the Shan States and up to Lashio altered the whole picture. It was obvious

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we must clear all hospitals out of Maymyo and that the whole force would have to retreat up the north-west routes to India. But we had the best part of 1,600 patients then in Maymyo; the hospitals in Mandalay were shut and on the move; we did not know even whether 4 Bur. G.H. was ready in Myitkyina; 1 Bur. G.H. was crammed full at Shwebo as was 6 Bur. G.H. at Sagaign. 2 Bur. G.H. and 2 C.C.S. were at Monywa, but not yet ready: the hospital ships were crammed and 900 more patients said to be on the way up and of the ambulance trains one was away up to Shwebo, the other derailed near Meiktila!

The Chinese were in worse plight because they had some 2,000 patients with nowhere to put them.

We pushed patients off to Monywa, to Myitkyina and Shwebo by any trains available: advanced parties of 8, 3 and 7 Bur. G.H. and 41 I.G.H. were sent off to Mohiyin, Katha, Bhamo; Moffat, A.D.M.S. L. of C. went off to Myitkyina and Mohiyin, but got involved in and delayed by a sabotage derailment: the ambulance trains were rescued and working alternatively up to Maymyo, and 60 I.G.H. from Mandalay was sited and very quickly accommodated at a Tawmaw hutted hospital at Chaukmyaung, on the river 17 miles east of Shwebo.

The plan worked on at that time and right through the final stages of the retreat was to have medical units to hold patients at stages, pass them on and then each most advanced unit in its turn to leap-frog right back past all the rest and be available to function once more much farther back.

A.D.M.S. 17 Div. used the same method in the fighting retreat of that Division. In fact it is the only satisfactory method.

The Final Trains From Maymyo.

We thus came to the last two days with patients reduced and hospitals ready to move with minimum, essential kit. We got one train away with some 500 patients plus personnel, etc., but still had all the serious cases left and then No. 2 Ambulance Train most opportunely rolled up.

Darrell, D.A.D.M.S., was indefatigable in making every arrangement and it was largely due to him things went so smoothly. The Chinese rather upset matters by taking trains and running them against all signals and timings.

We added five coaches to that ambulance train and put 438 patients, 73 nursing staff, the essential equipment of two general hospitals and essential personnel to run them, the district lab. and its equipment, the dental lab. and its equipment and a party of the R.A.M.C. Depot on that train.

The engine could not start it up the hill, so the train had to be split. It got away at 0900 hours next morning, it stayed twenty-four hours at the next station, the engine drivers bolted and French, in Command, had to go and get two volunteers from near Mandalay, it took five days for a twenty-four hours' journey to Myitkyina, but it got there and all patients and nursing staffs were evacuated by air to India.

For the balance, we put 50 patients and some 200 personnel on a mixed convoy of all the ambulance cars and lorries we could lay hands on and they drove to Shwebo. From there they went on by various trains northwards.

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Having seen the last lot off, I slipped down to Zuringgyi station to make sure that the ambulance train had gone. It had left twenty minutes previously. I looked in at Mohaung Station but it had not reached there, but I got a promise from Railway H.Q. that it would be run through that evening. In Mandalay I found all set for clearing across the river, at Sagaign I contacted the various hospital ships, found 5 Bur. G.H. had cleared out on "Siam" without helping anyone else, saw Eames and 6 Bur. G.H., Mrs. Jones the matron had been doing magnificent work and while I was there was dressing a number of Chinese battle casualties. Eames by his own initiative and later on by Coppinger's help got away his 600 patients by train and steamer. I saw Maung Gyi and his B.H.C. and arranged for them to clear out, but could get no transport for them. Here again Coppinger came to their assistance. There was a heavy bombing raid on Yawataung Station. From half a mile away it sounded quite severe, but the casualties were 1 killed, 2 injured. I contacted Dalziel and his 13 Lt. Fd. Amb., the D.A.D.H. 17 Div. and 50 and 23 Fd. Ambs., Corps H.Q. and so came once more to Shwebo where our H.Q. were ensconced in the F.F. Barracks.

Arrangement for the Final Retreat.

From now on the whole affair became more personal, mainly because of the difficulty of communication and ability to supervise the use and movement of units.

For the northern area Moffat, who was already up there, had to be entirely responsible, but there was no means of communication and once personnel went north on the trains or river they were out of touch and control.

Shwebo was not much of a place. Water was scarce, a raid on the station had not done much damage, but two raids of 30 planes smashed and set the whole place on fire; a very nice, recently purchased bicycle of mine disappeared into this. Kinu, the next station up the line, was similarly treated. 1 Bur. G.H. now under Anaswami, Tarapore having been evacuated sick, had done a lot of good work but by now only had some 200 patients. Even now they were getting some away by air. The civil hospital was deserted and we found a mixture of patients left unattended, one a padre who had been cut up by treacherous Burmans.

We got orders to send off all spare personnel, so off they went to Monywa bound for Kalewa. Unfortunately the Japs attacked the place by water and air and these advanced parties found themselves back on the Ye-U track.

Units for the Stages.

In order to find units for the stages I had to get hold of our C.C.S.s, intending to use them, one on every stage, viz. really as staging sections but with a much bigger scope. It was amazing how just the right units popped up just at the right time for any particular job. Slipping down to Chaukmyaung on the river I waylaid H.S. "Mysore," picked 8 C.C.S. off her, crammed 60 I.G.H. on instead, picked 4 C.C.S. off the "Assam." The two C.C.S.s were given orders to make themselves mobile by hook or by crook, buying bullock

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carts if necessary and to get to Ye-U at the earliest moment. "Siam" with 5 Bur. G.H. had already beat it up-river to Katha. Captain H. Railstone, the Captain of the "Mysore" overcoming all difficulties with his usual cool confidence took on the whole flotilla of hospital ships and away they all went to Katha.

To complete their story Major Joshi was in command of the majority and Gurbuksh Singh in command of 60 I.G.H. They got all serious cases away by train from Katha to Myitkyina and marched out by various routes with the remainder.

Having collected various medical units the following dispositions were made:—

(1) Shwebo: 1 Bur. G.H. to empty itself by train and then clear out by train. This they were unable to do and they marched out via the Kalewa route being used as an auxiliary unit at Kalewa.

(2) Ye-U: 2 Bur. G.H. having been driven out of Monywa was used here; and then leap-frogged through to Yesaggyo.

(3) 1 C.C.S. from Meiktila-Shwebo, then to Imbaung where it functioned for six days and did an enormous amount of work. Then to Imphal where it assisted the C.I.M.H.

(4) Pyingyaung: 2 B.S.S. from Mandalay. This eventually came out via Mauleik and Tamu.

(5) 22 mile Stage: 8. C.C.S. for a short time, and then leap-frogged to Whitok and then to Imphal. 8 C.C.S. has worked at Imphal since that time.

(6) Shewogin: 4 C.C.S., which leap-frogged through to Khampot. Extemporized A.H.Q.—ambulance party.

(7) Kalewa: 2 Bur. G.H. which stepped up to Yesaggyo.
2 C.C.S. which stepped up to Tamu.
"Friends Ambulance unit" which for forty-eight hours ran a very fine show and then went up to Khampot and then out to India.
1 Fd. Amb. which for six days ran a very good show then when relieved by 23 Fd. Amb. stepped to Lockchaw and Kanglatombi reception camp where it was working at the end of May.

(8) Imbaung: 1 C.C.S. until relieved by 37 Fd. Amb.

(9) Yessaggyo: 2 Bur. G.H. until relieved by 23 Fd. Amb.

(10) Khampot: 4 C.C.S. until relieved by 37 Fd. Amb.

(11) Whitok: 8 C.C.S. until relieved by 23 Fd. Amb.

(12) Tamu: 2 C.C.S. until relieved by 37 Fd. Amb.

(13) Lockchaw: 16 I.S.S. and 1 Fd. Amb. until relieved by 23 Fd. Amb.

(14) The Saddle: Special S.S. Capts. Lusk and Hart until relieved by 37 Fd. Amb.

(15) Pallel: 40 B.S.S. from India and a C.I.M.H. which refused to touch any Burman cases.

(16) Imphal: C.I.M.H. and I.C.C.S. for a time, then 8 C.C.S. then 13 C.C.S. from India.

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This gives, I think, a fairly clear picture of how units were used, how stages were set out, usually at about 15 to 20 mile intervals, and how, by using C.C.S.s a considerable degree of real treatment, operative and medicinal, within the limits of the equipment available, was made possible.

2 C.C.S. at Tamu was the numerical check on cases passing through. This had 2,300 sick and wounded entered in the A. and D. Book in the ten days it was functioning there. 2 Bur. G.H. from Monywa came to Ye-U with a lot of casualties. These we tried to pass up by train through Shwebo, but the line was gone and they and all cases in 1 Bur. G.H. had to be carried through the Kalewa route. The bombing of Kinu gave us some bad cases.

Bur. Corps and Bur. Div. came in from Monywa and commenced retiring up the line. 17 Div. and the Armd. Bde. meanwhile were away down south near the Sagaign Bridge and MacAlevey as usual away down with his farthest Fd. Amb. However, after midnight on the 2nd I. managed to contact him with 37 Fd. Amb. in Ye-U and found things seemed to be going satisfactorily.

On the 1st we heard that 1 Amb. train had been derailed 17 miles south of Shwebo, this was a deliberate derailment meant for a Chinese troop train. I sent Coppinger off at 11 p.m. to find out about them. He drove his jeep down the railway line, found the train staff had been attacked by locals but the Keren Sisters had managed to make peace, he picked up the four ladies on his jeep and drove off to Ye-U, went to sleep along the canal bank, upset into the canal and was pinned with the Keren Sisters under the machine for some time, were rescued, cleaned the engine and drove on through Ye-U to Kaduma. These four ladies got through all right, doing excellent work at the various stages.

And so the great trek went through. There were numerous incidents but the main impressions were of dust: endless streams of patients for whom transport had to be found; streams of refugees plodding along, the children happy and well fed, the elders looking desperate: and of troops feeling that if they could only get a chance and air support they would knock the Jap out.

Two medical incidents are worth recording.

1 C.C.S. carrying their equipment with, I think, one ambulance car marched 27 miles from Kalewa to Imbaung, arrived there in the evening, had 50 patients in within the hour, did five major operations that night and by next morning had settled into a routine disposal of 150 to 200 casualties a day.

2 C.C.S. set off from Kalewa for Imbaung and the farther line. The O.C., O'Neill, and Allinson, his second, carrying a bamboo pole on which were slung all the necessary surgical equipment for immediate emergency work. They functioned with what the personnel could carry for ten days at Tamu.

Final Journeys.

I went up the line to Imphal and Dimapur twice and then right back to the Fd. Ambs. 37 and 23 at Khampot to see that all was well and all patients were being got away. I met the Divisional Commander, 17 Div., who eulogized

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the work of his A.D.M.S. MacAlevey (later Brigadier G. A. M., *C.B.E., D.S.O.*).

Then as the last brigades came in, back we came on the final trip to Imphal in time to see the opening of the Monsoon at Palel.

NUMBERS CARRIED.

At a rough calculation, since accurate figures have been lost, we carried and brought out from Burma after the closure of Rangoon, except some 15 or 20 cases which were left at Mohnyin, approximately 6,006 sick and wounded; brought back by various means to India from the Burma retreat.

SOME GENERAL POINTS.

Fitness of Personnel.—An episode like this shows that all personnel of all units must be really fit, physically and mentally, and must be maintained in fitness by marching and exercise. I know that I am supposed to be a faddist, some may even say a maniac, on the subject of fitness and exercise. But it does seem obvious that many officers, particularly service and departmental officers, forget or do not realize that it is part of their duty to maintain the physical fitness of themselves and of the personnel under their charge, no matter what their age or job. It is emergencies such as this retreat which so markedly show up the unfit. The modern habit of cocktail drinking, bar-lounging and chain-smoking cannot be said to lend themselves to real physical and mental fitness. Even the so-called sedentary work of office or hospital may well entail ten to twelve to fourteen or sixteen hours a day hard at it for days on end and little that is actually sedentary about it. A man must be fit, physically and mentally, to stand even that strain.

As a side-light on this and the next paragraph it may interest you to know that at Basra in 1941 out of 17 officers on Movement Control Staff, between June and October, all except 4 were admitted to hospital, the majority for invalidment. What handicap this kind of inefficiency may become!

Elderly personnel require rigid examination before being kept on active service. We were afflicted time and again by elderly officers and other ranks cracking up at awkward times, not only medical but personnel of all branches. Of medical personnel alone 9 senior officers collapsed at critical periods. Fortunately their places could be filled.

Mobility of Units.—Units must be self-mobile. Pooled transport can never be spared for "medical" at really urgent periods and some form of unit transport appears to be essential.

The Scope of Control.—We were given to understand that India would make all arrangements from Tamu onwards. Of course we came out too quickly and no arrangements were set. Luckily I had gone up to see what arrangements had been made and, finding none, could continue our own chain onwards.

The Value of Nursing Service Personnel in all Medical Units.—With I.H.C. and B.H.C. nursing orderlies so inadequately trained a policy of obtaining all the Sisters, nurses and V.A.D.s whom we could and putting them into every

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non-divisional unit had a most beneficial result. It is a policy well worth maintaining.

Motor Training for all Superior Medical Personnel.—Time and again the need was apparent to have all officers and superior medical personnel trained. not only to drive motor vehicles, but to be able to repair and service them as and when required. In the early stages we lost 4 Amb. cars because the drivers bolted with the keys and no one present knew how to connect up the wiring. In the later stages those units always got on best who had real mechanics amongst their officers or superior other ranks. Practically all our units acquired scrounged or repaired vehicles. But beware of the confident B.O.R. who says he can drive and promptly wrecks a perfectly good vehicle.

Cholera.—There is too much tendency to label every severe condition "Cholera" when cholera is about and to neglect cerebral malaria or acute dysentery as a diagnosis.

Malaria.—This was making itself evident in the last two weeks. M.T. and B.T. of apparently most virulent strains are common and malaria must be excluded before making another diagnosis of any severe case. At a guess one would say that 85 per cent of the force will eventually show infection.

The B.H.C.—The achievement of Major Maung Maung Gyi, I.M.S., in command of this unit is worth recording. He was distinctly left in the lurch by L. of C. at Sagaign. He managed to get all the families away on a ship, 450 women and children, to Katha. He then, using one lorry for ferrying purposes for rations etc., marched his 250 men 270 miles successfully from Sagaign to Tamu. Having brought them out of Burma, he begged leave of me by letter and went off back to Sagaign to see to the safety of his own family whom he had left there. He is a well-known person and I am afraid will be betrayed to the Japs for his loyalty to us.

His Assistant Surgeon Eyles, in spite of an injured leg continued the march and on foot brought the whole unit out to the reception camps in the Imphal area.

The R.A.M.C. Depot, Maymyo.

Under the energetic leadership of Major Clarke and R.S.M. Harding this unit made itself mobile on repaired lorries for the move from Maymyo to Shwebo; went by train to Nabha; and then had to march out to Tamu bringing with them by personal carriage all their accounts, cash and records of all the R.A.M.C. in Burma.

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THE WHITE CELL COUNT IN EARLY SYPHILIS OF MALES

BY

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QUITE apart from the leukæmoid blood pictures occasionally seen in patients suffering from congenital syphilis, a changed white cell count in the secondary stage has been not infrequently reported through the years.

Cummer [1] quoted the 1894 edition of Morrow's "System of Genito-urinary Diseases" [7] as describing the results of investigations of the blood in 20 patients with assorted syphilis. It is observed that both the red and white cell counts and the hæmoglobin content are modified even before the appearance of the eruption and that, in the period of the syphilodermas, the hæmoglobin and the red cells diminish while the white cells increase and that, by the time the cutaneous eruption disappears the percentage of hæmoglobin returns to normal. Eason [2] cites Hazen [4] as saying in 1913 that in an untreated case of secondary syphilis there is a slight leucocytosis, an occasional patient showing as many as 20,000 cells per c.mm. and that severe cases show a higher polymorphonuclear leucocyte count than the mild, and that patients showing a high polymorphonuclear and a low lymphocyte count possibly do not respond as well to treatment as the reverse.

To-day the standard textbooks give somewhat divergent information on the subject of the white cell count in early syphilis, and a considerable number do not refer to the matter at all. Thus Whitby and Britton [10] state: "Leucocytes *usually* number from 12,000 to 20,000 in the secondary stages, the increase being brought about by an absolute lymphocytosis amounting to some 50 per cent of the total count." Many syphilitics also have an eosinophilia (Spangler [9]).

In Downey's "Handbook of Hæmatology," Hall [3] writes that in syphilis both in humans and in rabbits experimentally infected with the disease, it seems generally agreed that a monocytosis occurs in the blood-stream in the majority of cases. Mercer [6] reports a monocytosis in 75 per cent of early uncomplicated lues. Supravital staining was however employed in this work.

Secondary syphilis is listed as one of the causes of lymphocytosis by Wintrobe [12], and Piney [8] says that early constitutional syphilis is occasionally accompanied by anæmia which may be associated with a leucocytosis, though both these conditions are more common in women. McLachlen [5] on the other hand

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says that a slight or moderate leucocytosis may occur in secondary syphilis though the differential count is usually within normal limits.

Many of these statements are not borne out by this investigation which is an analysis of the white cell counts of 405 male Service patients personally treated for early syphilis. This total is made up of 166 cases of seronegative primary syphilis, 164 cases of seropositive primary syphilis and 75 cases of secondary syphilis. The proportion of secondary cases (18·5 per cent) compares with 17·2 per cent of 556 similar cases treated at the same military hospital during the years preceding this investigation [11]. All were adult males of an average of 27·7 years which is 1·6 years lower than the average of the earlier group just mentioned.

The vast majority of the blood-counts were performed to a standard technique by the same technician. They were done soon after the patient was admitted to hospital though several cases had commenced penicillin therapy some hours before.

Total White Cell Counts.

The average total white counts are as follows:—

Seronegative primary syphilis	8,850 per c.mm.
Seropositive primary syphilis	9,050 per c.mm.
Secondary syphilis	9,000 per c.mm.

The difference is extremely small. The actual numbers of cases where the total count exceeds 12,000 cells per c.mm. likewise show no startling distinctions for the three groups.

	No. cases	No. over 12,000	per cent
Seronegative primary syphilis	166	20	12·0
Seropositive primary syphilis	164	30	18·3
Secondary syphilis	75	10	13·3

Polymorphonuclear Neutrophils.

The average absolute and percentage neutrophil counts are as follows.

Seronegative primary syphilis	5,530	62·5 per cent
Seropositive primary syphilis	5,610	62·0 per cent
Secondary syphilis	5,535	61·5 per cent

Thus no essential differences are detectable in the neutrophil count or in the proportions of each group falling in the different ranges.

Range	Seronegative primary per cent	Seropositive primary per cent	Secondary syphilis per cent
Above 9,000	6	4	3
7,000—9,000	21	22	21
4,000—6,000	59	65	64
Below 4,000	14	9	12
	—	—	—
	100	100	100

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Lymphocytes.

In the secondary stage there is an increase of the total number of lymphocytes of about one-twentieth and a corresponding rise of about 1 per cent in the differential count at the expense of the polymorphonuclear neutrophils, both findings being within the experimental error of the assessment.

Seronegative primary syphilis	2,760	31 per cent
Seropositive primary syphilis	2,870	31·5 per cent
Secondary syphilis	2,900	32 per cent

The percentages of the total numbers of lymphocyte counts falling in the different ranges are set out in the following table:—

Range	Seronegative primary per cent	Seropositive primary per cent	Secondary syphilis per cent
3,500 and above	25	25	27
2,000—3,000	68	65	70
1,500 and below	7	10	3
	—	—	—
	100	100	100

High percentage lymphocyte counts are rare in this series. A 40 per cent or over lymphocyte count occurs only in 13·25 per cent of seronegative primaries (22 cases), 17·1 per cent of seropositive primaries (28 cases) and 18·7 per cent of secondary counts (14 cases) while the figures for the three groups where the lymphocyte percentage exceeds fifty are 2·4 per cent, 2·4 per cent and 2·7 per cent respectively (4, 4, 2).

Large Mononuclears.

The percentages of the total number of counts where the differential percentage of large mononuclear cells exceed 7·5 are 9·0 per cent (15 counts) for seronegative primary syphilis, 6·1 per cent (10 counts) for seropositive primary syphilis and 12·0 per cent (9 counts) for secondary syphilis. Thus a monocytosis appears slightly more apt to arise in secondary syphilis, though this is insufficient to disturb the average percentage counts of the series which is 4·5 per cent for all three groups while the absolute counts are 410, 420 and 400 respectively.

Eosinophils.

The average eosinophil counts are also steady and average 1·5 per cent in all forms, the totals being 120, 125 and 135 respectively. The differential eosinophil percentage exceeds 2·5 per cent in 17·5 per cent of seronegative primaries (29 cases), 15·9 per cent of seropositive primaries (26 cases) and 13·3 per cent of patients with secondary syphilis (10 cases). Thus the overall picture of the eosinophil counts shows no significant changes.

Basophils.

The basophil counts show no differences, the average totals being 30, 25 and 30 respectively for the three groups and the average differentials all being below 0·5 per cent. The relative numbers showing zero counts are approximately the same being 54·8 per cent, 53 per cent and 56 per cent respectively for the three

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groups (91, 87, and 42 counts respectively). Those showing counts greater than 0·5 per cent number 11, 11 and 5 respectively or 6·6 per cent, 6·7 per cent and 6·7 per cent.

Summary and Conclusions.

The white cell counts of 405 males suffering from early syphilis have been examined. The average count of all cases is as follows: Total white cells 8,950, neutrophils 5,560 (62 per cent); lymphocytes 2,830 (31·5 per cent); large mononuclears 410 (4·5 per cent); eosinophils 125 (1·5 per cent); basophils 25 (0·5 per cent).

No gross distinctions are to be observed between seronegative primary, seropositive primary and secondary syphilis.

Grateful acknowledgment is expressed to Pte. J. Mullis, R.A.M.C., for his performance of the cell counts and to Pte. J. Tomkins, R.A.M.C., for his assistance in the assembly of the data.

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THE TREATMENT OF ACUTE UNCOMPLICATED GONORRHŒA IN THE MALE BY MEANS OF A SINGLE INTRAMUSCULAR INJECTION OF OILY PENICILLIN B.P.[1]

BY

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In 1945 Romansky and Rittman reported that a single intramuscular injection of a suspension of 300,000 units of calcium penicillin in 1 c.c. of a 4·8 per cent beeswax and peanut-oil mixture maintained an effective level of penicillin in the blood serum for a period of about twenty-four hours. Previously the same workers had reported that eleven out of twelve patients with gonorrhœa had been cured by a single injection of penicillin in beeswax-peanut-oil mixture.

Since 1944, a number of papers have been written on the treatment of acute gonorrhœa by means of a single injection of penicillin in oil-wax suspension. Manson, Meads, Maxwell and Finland (1946), in an analysis of the literature through 1945, stated that single injections of oily penicillin and multiple aqueous intramuscular injections appear to give about equally good results, but that recent data would seem to suggest that an oily suspension in two doses gave better results, owing to the longer maintenance of the level of penicillin in the blood serum. Leifer, Martin and Kirby (1945) obtained a 91 per cent cure rate in 91 patients who received a single intramuscular injection of 300,000 units of penicillin in various concentrations of beeswax and peanut-oil. These cases were followed bacteriologically for three weeks. Frost, Allende, Kirby and Ginsberg (1947) treated 200 cases of acute gonorrhœal urethritis by means of a single subcutaneous injection of 300,000 units of penicillin suspended in 4·8 per cent beeswax and peanut-oil mixture. These observers obtained a cure rate of 88·5 per cent during a follow-up of twenty-one days.

Oily suspensions of penicillin have not been in general use in the Army for the treatment of gonorrhœa. It was therefore decided to treat, and follow up for a period of three months, a series of patients suffering from acute uncomplicated gonorrhœa by means of a commercial brand of Oily Penicillin B.P. of dependable potency in the V.D. wards of the Royal Herbert Hospital, Woolwich. The

[1] This paper describes the results of an investigation carried out at the instigation of the Sub-Committee on Venereology of the Army Medical and Personnel Research Panel.

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use of Oily Injection of Penicillin B.P. was decided upon as being the preparation of the type most readily available at the time. In view of the formula of Oily Injection of Penicillin B.P. (125,000 units of calcium penicillin suspended in 1 c.c. of arachis oil and 4·5 per cent beeswax) it was decided to use a dosage of 250,000 units (2 c.c. of the preparation). This was given as a single intramuscular injection on admission immediately following diagnosis.

Although the treatment is reduced to one injection as compared with four in the routine Army treatment (viz. a total of 200,000 units in four injections of 50,000 units at three-hourly intervals), the use of this preparation is not without its drawbacks, owing to the viscosity of the preparation at room temperature. In this connexion, recently, good results have been claimed using a new preparation of penicillin beeswax and peanut-oil which is fluid at room temperature (Hirsh, Dowling, Vivino and Rotman-Kavka, 1947). Also Brindle, Fairbrother and Jackson (1947) describe a preparation of non-hygroscopic sodium penicillin in 1 per cent beeswax and arachis oil (300,000 units per ml.) which is stated to give effective levels of penicillin after twenty-four hours. However, a routine was very soon devised and injections were given without difficulty or loss of the preparation, either from failure to empty the vial or syringe, or leakage from the syringe. The vial was warmed until the suspension was suitably fluid. The syringe and needle were heated at the same time. Care was taken that the syringe was completely dry before use. A 19 gauge needle was found to be the most convenient.

Selection, Diagnosis and Surveillance of Patients, etc.

The only selection of cases was by area in which stationed, and length of Army service remaining, it being necessary, in order to ensure adequate follow-up, to restrict this form of treatment to patients from units in the vicinity and to those who, as far as could be foretold, were not due for foreign or other postings, or for release in the immediate future.

Diagnosis in all cases was made by means of a urethral smear stained by Gram's method, which was confirmed by the culture of infective material inoculated on to a chocolate agar plate (using 5 per cent laked horse blood) and incubated immediately for twenty-four hours at 37° in an atmosphere containing approximately 10 per cent carbon dioxide. A specimen of blood for Wassermann reactions and quantitative Kahn test was taken in all cases prior to the commencement of treatment.

Treatment was commenced immediately following diagnosis by examination of urethral smear. This consisted of 2 c.c. of Oily Injection of Penicillin B.P. injected intramuscularly at the upper and outer quadrant of the buttock.

The morning following admission, if a urethral discharge or moisture was present a smear was made, stained by Gram's method and examined microscopically, and a culture plate inoculated with material expressed from the meatus. Even in the absence of obvious urethral discharge a culture plate was inoculated by platinum loop from the urethra. The patient's urine was also examined. If the results of these investigations proved to be negative the patient was dis-

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charged to duty to attend for post-treatment surveillance. Post-hospital surveillance was carried out as follows:—

(i) Examination of the patient for urethral discharge, inspection of urine for presence of pus or threads was carried out weekly for the first three weeks after discharge from hospital. The skin and mucosæ were also examined for signs of concomitant syphilis.

(ii) At the end of one month after completion of treatment, the patient was examined as in (i) above. In addition the prostate and vesicles were massaged, and the resultant secretion examined microscopically (bead and stained smear) and culturally.

(iii) Three months after completion of treatment the examination described in (i) and (ii) above were repeated. Wassermann reaction and quantitative Kahn test were also carried out. The patient was advised to have the W.R. and Kahn test repeated after a further interval of three months in order to exclude syphilitic infection masked by the penicillin treatment.

Treatment failure was postulated as the persistence of symptoms and/or positive microscopical and cultural findings during the period immediately following treatment, and relapse as the recurrence of symptoms or positive laboratory findings during surveillance.

In addition to the foregoing investigations, in a certain number of cases the presence or absence of penicillin in the patient's blood serum was determined at intervals of six, twelve, eighteen and twenty-four hours after treatment.

Results of Treatment.

In spite of every care in selection (*see* above), it was found impossible to follow up all patients for the full period of three months, owing to unpredictable postings and transfers of patients. Also, of the 65 patients examined at one month, prostatic cultures were not performed in 4 cases owing to lack of facilities at the station at which examination was carried out. This includes one patient who was asymptomatic but had a positive culture following prostatic massage when examined at the end of surveillance. Apart from these 4 patients all examinations during surveillance were carried out by one of us.

Of the total of 74 patients originally treated, 60 (including one asymptomatic patient with positive prostatic culture) were followed for the full three months. Of the remaining 14, 8 relapsed (*see* Table I) during this period, and 5 were lost

Table I.—Analysis of Follow-up

No. of cases treated	*No. followed for three months*		*No. followed for over one month and under three months*		*No. followed for under one month*		*Total*	
74	60*	81%	5*	6·7%	5*	12%	74	100%

*Including cases relapsing.

owing to the exigencies of the Service, and one case could not be considered, as he was found to be a latent syphilitic on first examination and was treated for this by means of 4 mega units of penicillin. No patient failed to respond to

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treatment, and apart from a slight mucoid discharge (rarely with up to 4 pus cells per field) all patients were asymptomatic the day following treatment, and in all cases urethral cultures were negative.

In no case were there any local or general reactions following the injection of oily penicillin, apart from a slight local discomfort persisting at the most for a few minutes.

Seven patients reported with a recurrence of symptoms during the first four weeks of their surveillance and, on examination, urethral smears revealed the presence of gonococci. These findings were confirmed by culture in each case.

Of the 65 patients who remained asymptomatic at the end of four weeks' surveillance, the prostatic secretion was found to be normal on microscopic and cultural examination in all of the cases, viz. 61 in which full investigations were carried out (*see* above).

Of the 61 patients followed for a period of more than one month, only one patient reported with a urethral discharge during the second and third months of surveillance, and in this patient gonococci were found to be present in the urethral discharge. As regards the remaining 60 who were followed for a full three months, all were found to be free from symptoms, and laboratory findings were negative in all cases, except for one patient, from whom gonococci were cultured from the prostatic secretion following prostatic massage (*see* Table II).

TABLE II.—INCIDENCE OF RELAPSE IN RELATION TO PERIOD OF SURVEILLANCE.

Week following treatment	*Total No. of cases relapsing*	*No. of relapse cases without history of fresh exposure*	*No. of cases admitting fresh exposure*
1	1	1	—
2	1	1	—
3	3	1	2
4	2	1	1
5	—	—	—
6	—	—	—
7	—	—	—
8	—	—	—
9	—	—	—
10	1	—	1
11	—	—	—
12	1	1*	—
Total	9	5	4

*Diagnosed by prostatic culture.

As will be seen from Table V, in all cases in which the gonococcus was found on microscopical examination of a smear, this was confirmed by the cultural findings. In one case, examined at the end of three months, stained smears of prostatic secretion, were negative, but gonococci were found in culture.

Relapse occurred in the majority of cases during the first four weeks—7 out of 9 cases (*see* Table II). It will be seen from Table III that out of 68 patients

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TABLE III.—RESULTS OF TREATMENT.

No. of cases originally treated	*No. of treatment failures*	*No. of cases defaulting before completion of surveillance*	*No. relapsed*	*No. of cases completing surveillance successfully*	*Total*
74	0	6*	9	59	74

*Includes one case treated for concomitant syphilis.

followed up for three months or until relapse occurred, 9 relapsed—a cure rate of 87 per cent. Of the 9 patients shown as having relapsed, 4 admitted exposure to reinfection within a few days of the recurrence of symptoms, having previously been symptom-free (*see* Table IV). If, as is possible, these patients were

TABLE IV.—ANALYSIS OF RELAPSE CASES IN RELATION TO EXPOSURE TO REINFECTION

Total No. cases relapsed	*No. relapse cases without history of fresh exposure*	*No. of relapse cases admitting exposure with known infected contact*	*No. of relapse cases admitting exposure with unknown contact*
9	5	2	2

TABLE V.—ANALYSIS OF BACTERIOLOGICAL FINDINGS.

No. patients treated	*Positive before treatment*		*Positive day following treatment*		*No. patients with recurrence of symptoms*	*Positive on examination*	
	Urethral smear	*Urethral culture*	*Urethral smear*	*Urethral culture*		*Urethral smear*	*Urethral culture*
74	74	74	0	0	8	8	8

No. patients examined one month after treatment	*Negative after one month*		*Final examination at three months after treatment*			
	Prostatic smear	*Prostatic culture*	*Prostatic Smear positive*	*Prostatic Smear negative*	*Prostatic Culture positive*	*Prostatic Culture negative*
65*	61	61	0	60	1	59

*Includes 4 patients examined at outstations where cultural examinations not possible.

in reality reporting with a reinfection and not a relapse, then the cure rate obtained would naturally be higher, viz. 92·7 per cent.

Those patients who relapsed were treated by means of 400,000 units of penicillin in aqueous solution in eight three-hourly intramuscular injections each of 50,000 units. All responded to treatment, except one patient, who had a further relapse two weeks later. This patient finally responded to a course of 600,000 units of penicillin over a period of thirty-three hours, followed by 5 grm. of sulphathiazole daily for five days.

No case under treatment developed syphilis during the period of surveillance.

As has been stated previously, in a certain number of the patients treated the serum penicillin was investigated at intervals following the administration of oily penicillin. Our experience was similar to that of many others in that the results obtained were found to be very variable. In 10 out of 33 sera, there was a slight degree of penicillin activity at twenty-four hours, as evidenced by the partial inhibition of the growth of the Oxford staphylococcus by pure serum. Somewhat more definite evidence of active penicillin in the serum was obtained after eighteen hours, since complete inhibition of the staphylococcus was produced by pure serum in 15 out of 24 of the sera examined at this interval. At

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twelve hours, of 17 sera examined complete inhibition occurred in 4 at a dilution of 1 : 8; in 1 at a dilution of 1 : 4; in 2 at a dilution of 1 : 2; and in 3 in pure serum. Partial inhibition of growth occurred with pure serum in the case of 2 specimens, and in 5 no inhibition occurred at all. 11 were examined at six hours. Of these 2 showed complete inhibition at a dilution of 1 : 4; 6 at 1 : 2; 1 in pure serum. One specimen caused partial inhibition with pure serum, and one failed to cause inhibition at all (*see* Table VI).

TABLE VI.—TABLE TO SHOW THE HIGHEST TITRE AT WHICH PENICILLIN IN SERUM OF PATIENTS FOLLOWING TREATMENT WITH A SINGLE INTRAMUSCULAR INJECTION OF 2 C.C. OF OILY SUSPENSION OF PENICILLIN B.P. CAUSED INHIBITION OF THE GROWTH OF STANDARD OXFORD STAPHYLOCOCCUS AT VARIOUS INTERVALS.

Case No.	6 *hours*	12 *hours*	18 *hours*	20 *hours*	24 *hours*
1	Nil	½	—	—	—
2	Pure ; p. ½	Nil	—	—	—
3	½ ; p. ¼	⅛	—	—	Nil
4	½ ; p. ¼	Pure ; p. ½	—	—	—
5	p. pure	p. pure	—	—	Nil
6	½	Nil	—	—	Nil
7	½	¼	—	—	Nil
8	¼ ; p. ⅛	½ ; p. ¼	—	—	Nil
9	½ ; p. ¼	⅛	—	—	Nil
10	¼	⅛	—	—	Nil
11	½	Pure	—	—	Nil
12	—	⅛	½	—	Nil
13	—	Nil	½	—	Nil
14	—	Pure	Pure	—	Nil
15	—	p. pure	p. pure	—	Nil
16	—	Nil	Unsatisfactory	—	Nil
17	—	Nil	Nil	—	Nil
18	—	—	Pure ; n. ½	Nil	Nil
19	—	—	Pure ; n. ½	Nil	Nil
20	—	—	Pure ; p. ½	Nil	Nil
21	—	—	Pure ; n. ½	Pure ; n. ½	p. pure
22	—	—	Pure ; n. ½	Pure ; n. ½	p. pure ; n. ½
23	—	—	Pure ; n. ½	p. pure ; n. ½	p. pure ; n. ½
24	—	—	Pure ; p. ½	Pure ; p. ½	p. pure ; n. ½
25	—	—	Pure ; p. ½	Pure ; n. ½	p. pure ; n. ½
26	—	—	Pure ; p. ½	Pure ; p. ½	p. pure ; n. ½
27	—	—	Nil	Nil	Nil
28	—	—	Nil	Nil	Nil
29	—	—	p. pure ; n. ½	p. pure ; n. ½	Nil
30	—	—	Pure ; p. ½	p. pure ; n. ½	p. pure ; n. ½
31	—	—	p. pure ; n. ½	Nil	Nil
32	—	—	Pure ; p. ½	p. pure ; n. ½	p. pure ; n. ½
33	—	—	p. pure	Nil	Nil
34	—	—	p. pure	Nil	Nil
35	—	—	Pure ; p. ½ ; n. ¼	Pure ; p. ½ ; n. ¼	p. pure ; n. ½
36	—	—	—	½ ; p. ¼	p. ½ ; n. ¼

Pure = Complete inhibition in neat serum. p. = Partial inhibition. Nil = Nil inhibition in neat serum. n. = Nil inhibition. ½ = Inhibition in serum diluted 1 : 2. ¼ = Inhibition in serum diluted 1 : 4. ⅛ = Inhibition in serum diluted 1 : 8.

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SUMMARY.

(1) The treatment of 74 male patients suffering from uncomplicated acute gonococcal urethritis by means of a single intramuscular injection of 2 c.c. of oily injection of penicillin B.P. (250,000 units) is described and the results tabulated and discussed.

(2) Of the 68 patients in the series who were adequately followed up, 59 (87 per cent) successfully completed three months' surveillance, and 8 had a recurrence of symptoms and bacteriological findings and 1 patient was found to have a positive prostatic culture at twelve weeks, although asymptomatic. Of the 8 patients cited as having relapsed, 4 were possible reinfections.

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RESUSCITATION OF LIMB AND ABDOMINAL WOUND CASES IN THE FIELD

BY

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THE following are some conclusions derived from experience as a transfusion officer in the field, in the European campaign from D-day onwards, through France, Belgium, Holland and Germany; and confirmed by a study of the fatality rate of cases with limb or abdominal wounds, a rate which in my view might be lowered considerably. The cause of this relatively high fatality rate I believe to be inadequate transfusion.

I have seen several transfusion officers at work, and have seen the results of the work of others (in those cases that had not died) in large numbers of wounded who had already had transfusions and surgical treatment, when working at the Casualty Evacuating Post (C.E.P.), through which 40,000 to 60,000 men, mainly wounded, were evacuated by sea to England from the Normandy Beachhead in the early part of the campaign. I was struck by their relative conservation both as regards the volume transfused and the rate of transfusion, and by the frequency with which I saw cases at the C.E.P. which required further blood transfusion, not from the point of view of correcting an anæmia—for which there is no urgency providing the blood volume has been restored (i.e. with plasma), but of counteracting persistent shock of varying degrees.

The remarks made here refer only to wounds of the limbs and penetrating abdominal wounds or to wounds of the body that have not involved the pleura or dura mater. Penetrating head or chest wounds and thoraco-abdominal wounds belong to an altogether different category as regards resuscitation and require conservative transfusion.

WOUND SHOCK IN LIMB AND ABDOMINAL WOUND CASES.

The cardinal signs of shock are: (1) A diminished volume of the pulse in systole and diastole, and (2) a diminished diastolic tension and systolic force of the pulse. It is extremely unfortunate that emphasis is always placed on the pulse volume alone. Usually both signs co-exist, but if one sign alone is present, as occurs after inadequate transfusion, shock is still present whatever the blood-pressure reading, and further transfusion is necessary.

Blood-pressure readings can be ignored except when they are low—and a systolic pressure of 115 mm.Hg or a diastolic pressure of 75 mm.Hg is low (in this case the pulse volume and tension are also low, either one or both). Many think that a systolic blood-pressure of 100 mm.Hg is a safe one. This is not so, there is nothing static about wound shock: even without further loss of

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blood the blood-pressure may fall, and any degree of shock is potentially dangerous. As far as the patient is concerned a mistake in the treatment of shock is only made once.

A pulse of poor volume and good tension in shock—the so-called "hard" pulse—may be a comparatively safe pulse, but even so transfusion is necessary to restore the volume to normal. Again, in shock, a patient with a soft pulse of good volume requires further transfusion to increase its tension and force: omission to do this leads frequently to a relapse of shock.

After transfusion the ideal pulse is either the "febrile" pulse of good volume, firm diastolic tension and vigorous systolic force, or the hypertensive pulse—terms which are self-explanatory—or, better still, the bounding pulse (and this may not appear until a short time after transfusion). With such an ideal pulse there is no possibility of a relapse of shock, unless of course further surgery is necessary or hæmorrhage occurs. In pulmonary œdema from over-transfusion a bounding pulse is present, but development of the former can always be prevented by making sure that the respiration rate does not rise above 20/minute during transfusion. If it does, the transfusion rate is slowed to a slow drip—perhaps only temporarily—and if the respiration rate does not return to normal within a few minutes, the transfusion is stopped altogether.

When during transfusion the patient's colour returns it is not necessarily an indication to discontinue transfusion at once.

Rapidity of the pulse is indicative of a dangerous degree of shock (with certainty) for which a rapid transfusion of a large volume of protein fluid will always be necessary. Yet with a slow pulse an equally dangerous degree of shock may be present.

It appears that whatever the causes of shock in these cases the circulation is depressed, and this depression is counteracted mechanically by the transfusion of protein fluid, so that it may not be of importance to know whether the shock is one chiefly to a diminished circulating blood volume, or otherwise. For this reason transfusion may lower the fatality rate in cases with perforated gastric or duodenal ulcers. It is necessary to transfuse frequently a greater volume of protein fluid than that which the patient would appear to have lost.

The moving of a patient from one place to another by any form of transport is undoubtedly the most important cause of an exacerbation of shock, but this will not occur if the initial transfusion was adequate.

Death from shock usually occurs from within a few minutes up to twenty-four hours; therefore in severe cases of these types transfusion must be rapid. Shock which persists will be aggravated by operation, and if he survives this, will lower the patient's resistance to infection. However, death from shock can probably occur even after some weeks.

Notes on Resuscitation.

Morphia ¼ gr. intravenously, repeated if necessary, relieves pain within a few seconds.

Detection of hæmorrhage is important from the point of view of priority of operation. Failure of resuscitation (where there is a very slight or no im-

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provement in volume and tension of the almost imperceptible pulse of a patient following rapid transfusion of 4 pints or more of protein fluid) is due usually either to external hæmorrhage from a limb wound or internal hæmorrhage from a penetrating abdominal wound (the missile perhaps entering the body posteriorly in the chest, buttock or thigh), or to gas gangrene or to irreversible shock.

The severely shocked case should be given oxygen by the B.L.B. mask—6 litres a minute being the usual minimum—and should be put in the "head-low" position. To do this, it is necessary to raise the end of the stretcher, operating table or bed as high as is possible without the patient sliding off. Those who feel thirsty, shiver, or complain of feeling cold may have lost a considerable amount of blood. The latter should be given extra blankets, but should not be "heated up" with stoves. It is unnecessary to warm a bottle of blood before transfusion.

Regarding choice of fluid, the more I used plasma the more I preferred blood, which I found to be more effective, probably in part owing to its greater viscosity. Many think that plasma alone is equally as life-saving as blood, but in any case a relatively larger number of bottles of the former has to be used, as there is a lesser volume of protein fluid in a bottle of plasma than in one of blood. Blood should always be used for severely shocked limb cases, all abdominal cases and for cases of gas gangrene. The fact that it is preferred for all serious cases is a tacit admission of its superiority to plasma. However, blood has the disadvantage that it does not run out of the bottle so easily, and some means must be found of overcoming this. It may not be available in quantity in which case it is usual to begin transfusion with two or three bottles of plasma and to continue with alternate bottles of blood and plasma.

I have seen cases who had been well resuscitated with plasma alone who were white as sheets, had bounding pulses and probable blood hæmoglobin estimations in the region of 30 per cent. Such cases would later require further transfusion of 8 or 9 pints of blood to restore the hæmoglobin to normal, or even half that volume if a "packed cell" transfusion was given. The use of blood alone would therefore have been preferable initially. Also, since on wounding blood is lost, it is more reasonable to replace the loss by blood than by plasma. Further, since with blood transfusion there is greater oxygenation of the tissues not only is shock immediately counteracted more effectively, but the body is later able to overcome more easily infections, such as a septic wound, gas gangrene, peritonitis or pneumonia. However, it is impracticable to provide blood alone for transfusion, although if it were not, I would use it alone for all wound shock cases.

Plasma is used for cases with burns, with an occasional bottle of blood.

The worst cases are always seen and transfused first. One reads occasionally of how cases, which are thought to have little chance of survival, are left in a corner whilst other less serious cases are treated. This is to be deplored since the really hopeless cases are rare. Recently I read of 2 cases with penetrating abdominal wounds on whom operation was not undertaken because they could not be fully resuscitated: and who later died. Again, one reads occasionally the phrase "too ill for operation." It should be remembered

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that, for example, a case with a penetrating abdominal wound with intraperitoneal hæmorrhage will not resuscitate fully with transfusion until the internal bleeding points have been tied or packed off. If the pulse cannot be improved sufficiently with rapid transfusion into one arm, blood must be transfused into both arms.

Limb wound cases with severe tissue damage should have priority over cases with penetrating abdominal wounds.

Rate of Transfusion.

Results of the treatment of wound shock cases were apparently disappointing in the early part of the blitz in England which was attributed to the fact that blood or plasma was transfused too slowly, being put up too frequently as a drip transfusion.

The correct rate of transfusion for limb or abdominal wound cases which are shocked is a transfusion of blood or plasma given as rapidly as is possible without causing a rise in respiration rate (the presence of which implies an incipient pulmonary œdema) until the pulse has been restored to the condition previously described.

It is of interest that the Americans appreciate the importance of a rapid rate of flow during transfusion, for on their plasma-giving sets there is no screw to control the rate of flow of the plasma, which therefore runs into the vein.

Unfortunately, in order to make the blood or plasma run (i.e. not drip) into the veins through the British giving sets positive pressure, sometimes considerable, usually has to be applied, and there is a very real danger of death from air embolism, if the bottle is allowed to empty completely.

In practice, the moderately shocked limb wound case will tolerate the first two pints of protein fluid run into circulation, but with blood or plasma from the third bottle running in, the respiration rate begins to rise, and the rate must be altered to a slow drip for a few minutes, when the respiration rate will fall to normal. Again the fluid is run in for a few minutes, and this process of alternate "dripping" and "running" is continued until the pulse volume and tension are fully restored, when the case is sent to the theatre with a drip transfusion.

The severely shocked limb wound case who has, for example, a traumatic amputation, multiple severe injuries, or much tissue damage, may tolerate the rapid transfusion of 10 pints of protein fluid (preferably blood) without a rise in respiration rate, the fluid being run almost continuously (i.e. not dripped) into the circulation within an hour or two, through intravenous sets put up on both arms simultaneously, before the pulse is restored and the case fit to undergo operation.

The more rapid the transfusion the more quickly the pulse volume and tension increases, and the more quickly the shock is overcome.

With the failure of resuscitation from hæmorrhage, or where there is a relapse of shock it is necessary to run in (i.e. not "drip") the blood during transfusion and to transfuse simultaneously into both arms.

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A slow rate of transfusion in the above types of cases may cause death. since the patient dies from shock before the requisite volume has been transfused.

Rigors.

Rapid transfusion may cause a rigor, in which case the rate should be slowed—perhaps temporarily—and the patient given extra blankets. The patient should always be asked if he has backache at the same time as, if present, this is indicative of the transfusion of incompatible blood. In this case, the transfusion is stopped at once, and a small quantity of compatible blood is transfused, followed by intravenous alkalis. The only case of apparent incompatible transfusion, which I saw, had no backache, but a few cases which had a deterioration of the pulse in "association" with a rigor caused me to replace the bottle of blood with a fresh one, since usually a rigor did not affect the quality of the pulse.

If a rigor occurred immediately a new bottle of blood was put up, the latter was always replaced by another bottle.

Rapid transfusion sometimes causes abdominal pain and vomiting. and where there is a penetrating abdominal wound may give rise to an exacerbation of abdominal pain. It may therefore be of value of preventing ileus by promoting peristalsis, but this effect may be only temporary.

The Volume of Protein Fluid Transfused.

The average volume of protein fluid given to each case transfused was 3 pints (bottles) in the African campaign, and again 3 pints in the Italy and Sicily campaign. That the average for each campaign was found afterwards to be the same might be a cause for satisfaction that the average volume transfused was "correct" and sufficient. My own average in the B.L.A. including head and chest cases, would have been perhaps double this, perhaps more.

It is customary to refer to a bottle of blood or plasma as a pint bottle; however, of this pint or so of fluid, only about two-thirds is protein fluid, the remainder being citrate solution, glucose solution or distilled water, which has been added. Therefore 3 bottles of blood or plasma contain approximately only 2 pints of blood or plasma.

I found that cases with limb wounds who were moderately shocked would usually require a transfusion of from 4 to 8 bottles of protein fluid before operation, the average case being fit for operation with the fifth or sixth pint dripping into the circulation. Two cases of wound shock might have exactly similar pulses as regards volume, tension and force, but one might require double the volume of fluid transfused compared with the other, in order to transform the pulses to a precisely similar safe level. Allowing for quick surgery without excessive hæmorrhage 5 to 9 pints (bottles) of protein fluid may be sufficient.

The severely shocked case, with one or more limb wounds, such as a traumatic amputation, who has an almost impalpable and perhaps rapid pulse. may not be fit for operation until 10 pints or more of protein fluid have been transfused rapidly, and may have been given 11 or 12 pints by the end of

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the operation. One double amputation case was given 16 pints in six or eight hours.

Cases with penetrating abdominal wounds, usually with associated internal hæmorrhage, were usually given about 6 pints or more before operation, performed one and a half to two hours after transfusion was begun, and a total of 8 to 12 pints by the end of the operation, the average usually being 9 or 10 pints. Some of the blood transfused before operation would be lost into the peritoneal cavity, but this is no indication for conservative transfusion. One exceptional case with a perforated cæcum which had prolapsed through a wound of the right iliac fossa was given a transfusion of a pint only before operation, and it was probably not necessary even to have given this.

Each case is different from the next, and requires the exercise of judgment regarding the rate and volume to be transfused. Volume and rate of transfusion go hand in hand—a case requiring a large volume being transfused rapidly.

One should consider not the probable volume of blood lost by the patient (for histories are notoriously inaccurate), nor the volume of blood or plasma already transfused, nor the blood-pressure—unless low, but the degree of shock of the patient, paying particular attention to the pulse volume, tension and force, and to the respiration rate.

Blood is only wasted if the patient develops a pulmonary œdema.

In all these cases the pulse should be restored to the ideal condition described before operation. This will not be so easily achieved with abdominal cases, or where there is hæmorrhage.

Resuscitation During Operation.

Transfusion begun by the transfusion officer is generally continued by the anæsthetist, who is usually content to allow the blood or plasma to drip into the patient's circulation. Rapid transfusion tends to neutralize the effect of the anæsthetic, and is therefore not very popular since the patient may begin to "come round," but nevertheless if the pulse warrants it transfusion should be rapid even if more anæsthetic has to be given. Since pentothal affects the pulse adversely some, but not a considerable, allowance may be made in assessing the degree of shock present when this anæsthetic is used.

The condition of the pulse would of course be very good if pulmonary œdema begins to occur from over transfusion.

Where possible oxygen should be given liberally in conjunction with transfusion, for the purpose of transfusion even of plasma alone is to improve the circulation of the blood so that the tissues and particularly the vital centres of the brain, and the heart, are provided with an adequate supply of oxygen.

The presence of a relapse of shock is rather a reflection on the transfusion officer than on the anæsthetist or surgeon, and is not usually a relapse at all, but merely a progressive development of shock which has never been properly overcome by transfusion of an adequate volume of protein fluid. In this case the *head end* of the patient should be lowered temporarily (or perhaps for some hours) even if the surgeon is inconvenienced. It is a waste of time to do a beautiful operation on a patient who dies shortly afterwards. Frequent blood-

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pressure readings are popular—however, in spite of them patients still die from shock during or soon after operation, and the anæsthetist should ensure that the blood or plasma *runs* continuously into the circulation, preferably with rapid transfusion into both arms simultaneously. Probably, in relapse, a minimum of a further 6 pints should be transfused no matter how much blood or plasma has been given previously.

Post-Operative Resuscitation.

From 2 to 5 pints of blood was usually transfused to cases with limb wounds —such as amputation cases—where after operation shock was still present without hæmorrhage; one such case was given 9 pints. In all these cases the previous transfusion (by someone else) which had been discontinued, had been inadequate; my own cases would have required much less.

Patients became much more vigorous mentally and physically post-operatively, and subjectively felt very much better after adequate transfusion.

For cases with penetrating abdominal wounds some surgeons unfortunately have a habit of ordering saline or glucose saline drip transfusion immediately after operation. The choice of fluid should be left to the resuscitation officer—many cases require many more pints of blood or plasma. Again, the present practice of most surgeons is to give one or two bottles of plasma daily for at least a week following operation, in addition to saline and glucose saline, to counteract hypoproteinæmia. Certainly, most of these abdominal cases require intravenous protein fluid post-operatively—the volume depending on the degree of shock that remains, and this should be given as quickly as it can be tolerated as death from shock usually occurs within twenty-four hours. The case that will tolerate 7 or 14 pints of plasma in the week following operation owing to inadequate transfusion should also tolerate such a volume of plasma (or of blood) in the day or two following operation. Dehydration of the patient need not be considered whilst transfusing protein fluid. If there is no medical officer to supervise the transfusion—for example, at night—plasma may be used, and the patient put on a half-hourly respiration chart, the nurse being given strict instructions that the respiration rate must not exceed 20/minute. If during the week the pulse again deteriorates a further transfusion of 2 to 5 pints might be given. That shock is often severe after operation is indicated by the fact that it was found to be the cause of death in nearly two-thirds of the cases in a series of abdominal wound cases investigated at post-mortem by Major Blackburn. R.A.M.C., and Major Robb, R.A.M.C.

In considering his fatality rate in limb and abdominal wound cases the surgeon should pay attention not to the skill or lack of it of either himself or his anæsthetist, but rather to the volume of protein fluid transfused, and to the rate of transfusion.

Irreversible Shock.

I saw only two such cases in association with severe tissue damage, both of whom died as the seventh and eighth pint was being transfused respectively. with transfusions running into both arms.

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More rapid transfusion of a large volume of blood might save such cases. It would be worth while transfusing 4 pints simultaneously into the circulation, with blood from 2 bottles running into each arm, transfusing 4, 8, 12, 16 and even 20 pints in an hour or two. A pressure pump might be devised to give really rapid transfusions.

Out of an indefinite number of limb cases transfused—such as amputation cases and cases with compound fractures—only one died, and here inadequate transfusion was partly responsible, succeeding hæmorrhage being the immediate cause of death.

Out of perhaps 40 or 50 cases with penetrating abdominal wounds 6 died, and 2 of these deaths were due to shock after operation and were avoidable. The first of the latter cases was, in my absence, given oxygen alone, whilst I was too slow to transfuse further the second whose condition seemed to be no worse than that of three other cases who required post-operative transfusion at the same time.

The importance of having a transfusion officer for post-operative work is stressed by the fact that cases of shock tend to die within the first twenty-four hours after operation, even if such a necessity is due usually to inadequate transfusion before and during operation.

The following excerpts are from the fatality figures from June 6, 1944, to August 1944, in Forward Surgical Units of the B.L.A.:—

	Deaths	*Total*	*Approx. Fatality Rate*
Penetrating abdominal wounds ...	505 ...	1,503 ...	1:3
Non-penetrating abdominal wounds ...	23 ...	197 ...	1:9
Amputations (arm)	9 ...	198 ...	1:22
Amputations (leg)	67 ...	474 ...	1:7
Compound fractures of femur ...	38 ...	644 ...	1:17
Penetrating knee-joint wounds ...	4 ...	240 ...	1:60
Maxillo-facial wounds	26 ...	887 ...	1:34
Gas gangrene	48 ...	167 ...	1:3

The corresponding figures for all limb wound cases which comprise 80 per cent of all wounds—including cases with compound fractures of the limb bones —were not given, unfortunately.

However, the fatality rate of these cases is seen to be high, and to explain this a considerable percentage of deaths must have been due to shock. The fatality rate from gas gangrene was surprisingly high, and inadequate transfusion must have been a main cause of this since penicillin was available—except initially for German P.O.W.s—although the dosage may not have been sufficiently heavy. One writer, Lieut.-Colonel Wood Power, R.A.M.C., found that arterial injury was always present in association with gas gangrene, so that one would expect blood loss to be severe.

Major Blackburn and Major Robb describe post-mortem findings on 78 cases with abdominal wounds out of 210 abdominal cases on which operation was undertaken. In 48 of these cases (61 per cent) death was due to "shock and hæmorrhage" and in 8 cases to bronchopneumonia or pulmonary œdema (the numbers of each were unspecified), so that for every one who died from over-

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transfusion perhaps 12 to 24 died from inadequate transfusion. Such a ratio would probably not be dissimilar in limb wound cases. It is as much an error of judgment to allow a case to die from shock owing to under-transfusion as it is for a case to die from pulmonary œdema from over-transfusion. When the number of deaths from pulmonary œdema begin to approximate in number those from shock—which will decrease correspondingly—it will at least be an advance, although it will indicate bad resuscitation. Major Blackburn and Major Robb concluded that "an elucidation of the problem of shock is the most likely road to improvement in the fatality rate of abdominal wounds."

Again in the Field Surgery Pocket Book (January 1944) it is stated that "the chief cause of death in cases with penetrating abdominal wounds is hæmorrhage.

Further, a medical research team in Italy found that "Blood volume studies show that medical officers generally underestimate the extent of blood loss."

Suggestions and Criticisms.

(1) Some means must be found whereby blood (and plasma) can be made to run (i.e. not drip) out of the bottle into the veins more easily with the minimum use of positive pressure, for even with the use of considerable pressure it does not always flow easily, whether by the use of wider needles or a more coarse mantle filter or by other means. If this can be done, not only will there be fewer deaths from air embolism but also, far more important, fewer deaths from shock, for it is the dangerous necessity of the frequent and sometimes ineffective use of the Higginson's syringe to make the fluid flow quickly that causes many to be content with a slow rate of transfusion. Again, if one is doing many transfusions simultaneously one may not have time to use positive pressure persistently on all, and this has to be delegated to an orderly who cannot appreciate the importance of a rapid rate of flow.

The bottles might also be provided with valves by means of which, when the bottle is nearly empty, the flow is stopped.

(2) Quart bottles of plasma, and if possible of blood, might be made up. These could be used initially for all cases with severe limb wounds or with penetrating abdominal wounds, pint bottles being used later on. The frequent changing of bottles means that a fewer number of transfusions can be attended to at the same time.

It is unfortunate that many have a fear of giving too much blood or plasma, and it may take years for this conservative attitude to give way.

(3) At the time of the invasion we were supplied with only 30 or 40 bottles of blood, although the refrigerator would have held many more bottles. More blood was unobtainable, although a request was made for it. This blood was soon expended, as in two or three days we used nearly 400 bottles of blood and plasma. For a short time therefore we had only plasma available for abdominal cases and severely shocked limb cases. Where the future is uncertain, there is all the more reason to be well stocked with supplies.

(4) There was at all times a marked shortage in the supply of oxygen. This

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may not have been easily available in England, but if that was not the case, it should have been supplied in far greater quantity.

(5) Two types of trestles of different height are supplied to the Army for the support of stretchers, enabling the patient to be put in the "head-low" position. The difference in the height of the trestles, at present only 5 in., should be increased.

(6) At the beginning of the invasion for the first few days there was an insufficiency of surgeons in our sector, who were actually operating. It is said that 30 British surgeons were landed at this time. During the month of June nearly 1,200 operations—admittedly major ones—were done out of 21,000 surgical casualties, an average of 1·6 (one point six) operations per surgeon per day.

Later, even many weeks after D-day cases who had compound fractures were being evacuated to England by sea without operation which they would not have had until the wound was two to four days old. Evacuation was good from the front line but initially the surgeons could not cope with the number of casualties, although these were a third of those anticipated. The number of operating surgeons operating initially might have been doubled or trebled to advantage, so that all except the slightly wounded might have had an early operation. What must be done in war can be done without attributing its impossibility to the exigencies of the service. Naturally the medical part of an Army has the lowest priority in battle, but more Field Surgical Units might have been functioning earlier, their transport being substituted for a part of that belonging to the evacuating Field Ambulances or Field Dressing Stations.

Those who object that highly skilled men should be exposed to danger unnecessarily should regard this as a compliment to the value of their work, and that in any case there is in Britain a profusion of good surgeons.

(7) All anæsthetists, surgical general duties officers (the equivalent of house surgeons), and battalion medical officers should attend a course in blood transfusion.

A larger number of medical orderlies in C.C.S.s and hospitals should be trained in transfusion work. There is at present only one transfusion orderly on the establishment of a 200-bedded hospital. An orderly who could be relied upon to change bottles of blood or plasma, and to keep transfusions running was invaluable. This meant that one could transfuse a greater number simultaneously. In all major surgical wards there should be full-time resuscitation orderlies for day and night post-operative work, with at least one spare orderly.

(8) An analysis of the average volume of blood and plasma given to those limb and abdominal wound cases who died from shock, and other causes, including gas gangrene, pneumonia and peritonitis, for comparison with the average volume given to those who lived, might be instructive. If the former volume is less than the latter the moral is obvious—and would perhaps stress the importance of a rapid rate of transfusion, and if the same or greater it still does not prove that a greater volume should not have been transfused in the former cases since, in those cases who died, shock was probably more severe.

(9) To what extent did avoidable deaths occur in wounded men before they

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could reach a surgical centre? To what extent did battalion medical officers (R.M.O.s) give transfusions? The majority of cases admitted to the advanced surgical centre requiring transfusion had been given none previously. R.M.O.s were in fact discouraged from giving transfusions as it was said that a case which has been resuscitated should be operated upon without delay, as otherwise a "relapse" of shock occurs, which further transfusion does not overcome so easily. As already stated this conception may be erroneous, a relapse of shock occurring (before, during or after operation) in a case that has never been fully resuscitated. But even R.M.O.s could give no answer to the above question for, although they know the numbers of men who died "on their hands," having had no real experience in most cases in blood transfusion, they could not know which of them might have been saved by really vigorous transfusion.

In Italy a research team, investigating the cause of death in those wounded who died on the battlefield, did post-mortems on 33 such cases. They found that in 42 per cent of cases hæmorrhage was the essential cause of death, and in a further 18 per cent of cases hæmorrhage was second in importance; and that there was a good prospect of recovery if medical attention had been available immediately after wounding—in 9 per cent of the cases and a fair prospect of recovery in 12 per cent (making a total of 21 per cent) of those cases who did in fact die. Their conclusion was that "although an important minority of deaths may be due to wounds that do not seem to be inherently lethal, the evidence favours the generally accepted belief that, having regard to the conditions of battle, very few men die who might have been saved."

Conditions of battle vary, as regards terrain, and are different for tank and infantry units, but by organization these adverse conditions may be partly overcome. The ideal is early arrest of hæmorrhage and transfusion, to ensure which it may be necessary to train stretcher bearers to give transfusions. For these urgent cases even a relatively "non-sterile" transfusion is better than none at all. This, I believe, is done in the American Army.

There may be a possibility of lowering considerably the mortality rate on the battlefield, by organization which provides the R.M.O. with a liberal supply of plasma and perhaps a dozen stretcher-bearers (divided amongst the companies) who have been trained to give transfusions. In order to save this 21 per cent of cases it is more likely that R.M.O.s would have to give to such cases a rapid transfusion of, not two or three bottles of plasma: but rather perhaps ten bottles before evacuation of the case to the surgical centre. These cases would comprise those wounded in which the pleura or dura mater had not been involved in the wound.

Conclusions.

I have endeavoured to show the need for transfusion which is adequate in rate and volume in wound cases where neither the pleura nor dura mater has been involved in the injury, where such transfusion should eliminate death from shock.

Other advantages are a lowering of the fatality rate in gas gangrene cases, and in infections such as post-operative pneumonia and peritonitis: a lessened

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incidence of cases with hypostatic congestion of the lungs—for a person who is adequately resuscitated is much more active in bed—and of cases with venous thrombi owing to the improvement of circulation—thrombi which on becoming dislodged causes sudden death. It may be of value in the prevention of traumatic anuria by raising the glomerular blood-pressure in the capillaries, and in the prevention of paralytic ileus in abdominal cases.

The same principles of transfusion apply in the transfusion of civilian casualties in peacetime although in cases with compound fractures, tissue damage, and therefore shock, would tend to be less severe.

Whereas transfusion has saved many thousands of lives in this war I think that considering the numbers of casualties of the blitz and of the campaigns in Africa, Italy, France and Germany and of the Far East more adequate transfusion might have saved more.

With thousands of deaths on the road yearly it should not be necessary to wait for the next war for transfusion to be put on a sound basis, and, if practised with greater skill and less timidity there may be a considerable improvement in the fatality rates of the types of cases described.

Summary.

(1) These remarks apply only to wound shock cases where neither the pleura nor the dura mater has been injured.

(2) In wound shock the cardinal signs are a diminution of the volume tension and force of the pulse. The blood-pressure, unless low, can be ignored, and if low the patient will require rapid transfusion of a large volume of protein fluid. In all cases one should endeavour to restore the pulse to a condition similar to that of a febrile, hypertensive, or bounding pulse. Restoration of the tension and force of the pulse is almost as equally important as of the volume.

(3) Blood is preferable to plasma transfusion in cases in which shock is severe.

(4) The blood or plasma should be given as quickly as is possible without causing a rise in the respiration rate. If the shock is severe, or there is a relapse of shock, the fluid should be run into the veins from 2 transfusion sets simultaneously. In relapse rapid transfusion of a minimum of 6 pints of protein fluid is probably necessary, whatever the volume already transfused.

(5) Limb wound cases who are moderately shocked are generally fit for operation with the fourth to the eighth pint—usually the fifth or sixth pint—dripping into the circulation, with speedy operation and little hæmorrhage 5 to 9 pints (bottles) may be sufficient.

Where shock is severe as in cases with traumatic amputations, etc., the patient may not be fit to undergo operation until the 10th pint is being transfused, and may have had 11 or 12 pints by the end of the operation.

Post-operative transfusion even of a large volume may be necessary even where there is no further hæmorrhage.

Where there is continued hæmorrhage, there is no limit to the volume that may be transfused.

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(6) For cases with penetrating abdominal wounds, where intraperitoneal hæmorrhage is usually present, transfusion of 6 pints of protein fluid is a reasonable volume to give before operation, with a total of 8 to 12 pints (usually 9 or 10) given by the end of the operation.

Depending on the degree of shock still present blood or plasma transfusion may be continued immediately after operation, and if it is intended to give one or two pints of plasma daily for a week, it is more reasonable to give this total volume in the day or two following operation, since death from shock usually occurs within twenty-four hours.

(7) The view that transfusion is frequently inadequate in these cases is based on my experience, on the observation of cases transfused by others, on the fact that further transfusion was frequently necessary on arrival of cases in England, and on the fatality rate of casualties in the B.L.A. In my opinion the value of transfusion is underestimated and the importance of complete resuscitation of cases hardly realized, even by surgeons.

(8) It is fitting here to pay a tribute to those, such as Brigadier Sir Lionel Whitby, who were responsible for the first class organization of the Blood Transfusion Service.

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Clinical and Other Notes.

ROUGH SHOOTING IN JAPAN.

BY

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In Southern Japan there is good rough shooting all over the area occupied by the British Commonwealth Forces. Pheasants of several varieties including the Golden Yamadori with tail feathers three to four feet long, are the most common game birds but, in addition, woodcock, quail, snipe and widgeon help to vary the bag. In certain areas hares are found, and in the more isolated hills, deer, bear and wild pig.

The country consists of pine-covered mountains, terraced on their lower slopes for crops of rice or wheat, rising steeply to a thousand feet or more above the blue waters of the Inland Sea.

Here and there paths wind up the mountain sides through orange groves, past valleys thick with bamboo clumps. Innumerable varieties of ferns grow thickly on the rocky hillsides in the damper places, while stunted bushes of azaleas and camellias cling precariously to the sunlit slopes. Eventually on the summit the path usually runs along a ridge with magnificent views of sea and mountains on either side, the more distant ranges hanging hazily in the sky.

In this type of country driving is difficult and all the odds are in favour of the game. As often as not, one is caught off one's balance and a snap shot is the most one can expect.

It was mid-October when we decided to try shooting over some islands near the entrance to the Inland Sea, where pheasants were reported to be plentiful.

A Japanese tug with crew was procured and four of us started off in the dark at 4 a.m. The plan was to pick up two more guns, some Japanese guides, and dogs en route. The guns consisted of six officers, two naval, one R.A.F. and myself from Kure, a Cameron Highlander and a Gunner from Matsuama, a town on the large Island of Shikoku about four hours' run by launch. Dawn was breaking as we came out of the long channel leading out from Kure harbour and in the distance the 7,000 foot mountain peaks of Shikoku were revealed in the pinkish haze of the sunrise. All around were the sails of Japanese fishing craft and occasionally we passed a sampan chugging along on its single cylinder engine. At Matsuama we drew alongside the jetty and the remaining guns and the two Japanese hunters, with a magnificent pair of trained pointer dogs, came on board. We left again at once and set off for the unknown islands.

By this time the sun was up, the sky was blue and the many islands were a vivid green like jewels set in the glittering sea.

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Soon we drew in close to the beach in a little island harbour. The shore was packed with sampans and nets, and thousands of whitebait lay in wooden trays drying in the sun.

Behind the beach a little fishing village of wooden houses lay huddled in the fold of the hills. As we landed, small boys surrounded us saying "Hullo" and "How are you?" their eyes agog at the sight of such large unusual looking men. We divided into two parties, each with a Japanese hunter and a dog, and set off in opposite directions, arranging to meet back at the tug for lunch. As the island was about two miles long and a mile wide with a ridge running from end to end about 700 to 1,000 feet high we decided that in this way we could cover most of the ground.

"Jackson's" Bay—Kegoya.

My party, consisting of one naval officer, the gunner and myself plus a Jap hunter and dog set off along a path which wound up the cliff through terraced rice fields and orange groves. Gradually we came near the summit with the dog working hard on either side. In among the pines I had just climbed up a rocky place on all fours when up got a hen pheasant from under my feet. A snap shot missed, but I got her with my second barrel just as she was disappearing over the crest. Immediately after, three more pheasants whirred up from the same place catching me unloaded. Below me came a bang, and I knew that the naval officer had had the satisfaction of bringing down a beautiful high bird as it sailed over the sunlit valley. Far below, the blue sea was lapping lazily on the sandy shore of a deserted cove seeming to invite us with its coolness.

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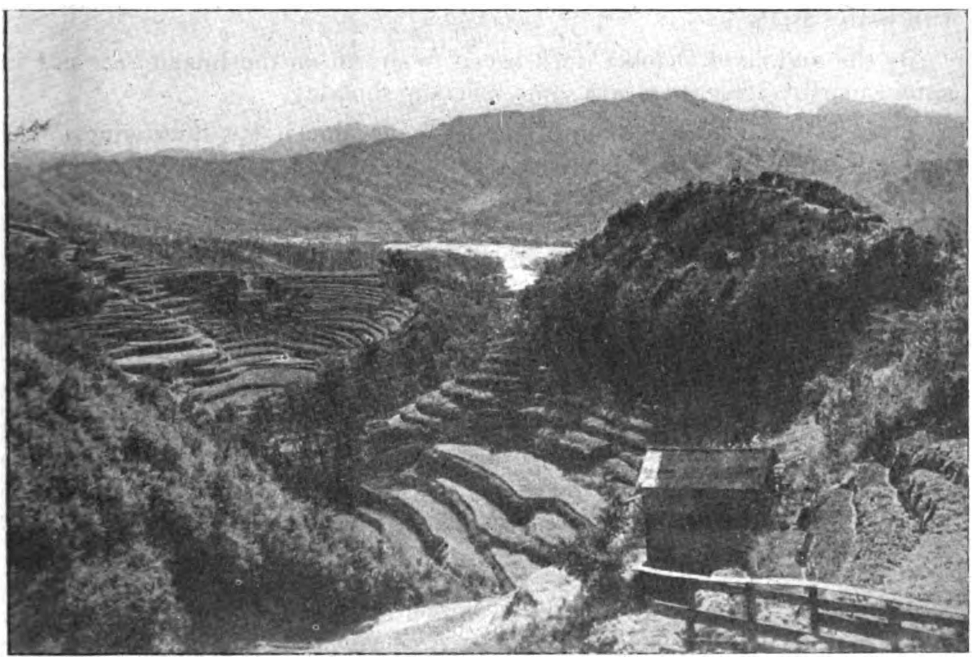
When we got back to the tug we had two pheasants and a widgeon. The other party had fared much the same.

After our picnic lunch we chugged across to another island, disembarked at a stone jetty and told the Japs in the tug to go round and wait the other side of the island.

Our guide set off in front and as we passed along the quiet village street little boys and girls in kimonos ran and hid in doorways to peep curiously after us. Finding us harmless they came out and followed calling "Hullo"—"Hullo" till we had to answer. We went along a cultivated valley and out on to a spur of the hill where fig trees and persimmons were growing amid long coarse grass. At once the dog pointed below me and I had to bound down



Towards Ondo Ferry.

three or four terraces to reach him just as a brace of pheasants got up and flew in different directions. John, the gunner, got one, and I the other. Another pheasant was bagged in an orange grove by the sailor and we must have seen at least a dozen before we zigzagged down the other side towards our tug. We could see it lying anchored in the little bay far below, and the other party was already walking along the beach towards it. Having given the fisherman a few cigarettes to take us out in his sampan to the tug, we settled down tired and happy to a well-earned drink and reminiscence.

The sun was setting as we started homewards, and steaming past the inverted wrecks of some of Japan's once mightiest battleships, we were reminded that the sun had indeed set over the Empire of the Rising Sun.

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Later in the season came a most welcome invitation to visit friends in the Mahratta Light Infantry on the northern coast on the Sea of Japan. This entailed a really beautiful motor journey of 100 miles right across the main Japanese island of Honshu over a mountain pass through snow-clad pine woods. Here the country was less steep and more undulating. Yamadori pheasants were as common as the others and my host twice got a right and left at woodcock. On one occasion my Jap guide insisted on taking me in to see a natural hot spring near where we were shooting. In large white-tiled baths filled with water from the spring were Japanese of both sexes, men, women and children unconcernedly basking and gossiping with each other.

It was near here that the dog put up five pheasants from the same place, on a hillside, and I had the satisfaction of seeing the smug Jap hunter miss with both barrels.

By the middle of October duck began to swarm on the Inland Sea, and in certain marshy areas there was some very fine shooting.

Japan is on one of the main migratory routes and it was interesting to see hundreds of mallard for a few days, for them to leave and then for the teal to come in in almost uncountable numbers. Later we saw widgeon, potchard, tufted, shoveller and shelldrake, and on the north coast thousands of geese appeared. For five or six weeks there was magnificent flighting before the duck moved on. In March they were coming back again and hundreds could again be found on the sea. We followed these in sampans, but usually they seemed to know the exact range of a shotgun and used to get up just beyond our reach. However, some early morning sorties were quite successful, and whatever the bag, the beauty of the "enchanted hour" before the sun rises to cast its rosy gleams through the mountain mists, was ample recompense.

AN IMPROVISED CONTINUOUS SUCTION APPARATUS, SUITABLE FOR PLEURAL EVACUATION.

BY

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SPONTANEOUS pneumothorax and pyopneumothorax frequently demand continuous pleural suction. Electrical suction pumps have been designed for this purpose but, at the present time, they are in very short supply and may not be available where and when they are wanted. The apparatus herewith illustrated can be improvised in almost any permanent hospital at short notice:—

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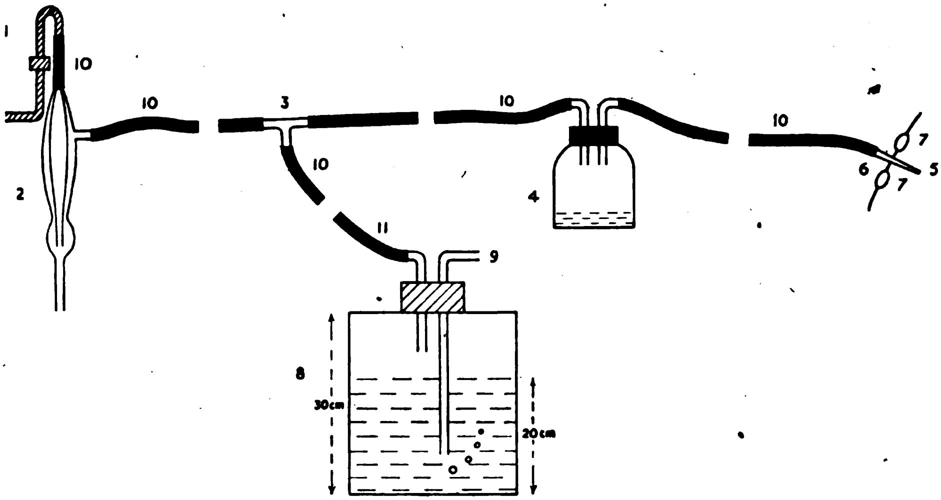
AN IMPROVISED CONTINUOUS SUCTION APPARATUS, SUITABLE FOR PLEURAL EVACUATION



1. Water tap. 2. Glass suction pump. 3. Three-way connexion. 4. Trap (capacity about ½ pint, and fitted with rubber stopper). 5. Pleural cavity. 6. Needle or catheter. 7. Ribs in section. 8. Suction relief chamber, fitted with greased cork stopper, and containing water. 9. Air-inlet tube—height adjustable. 10. Rubber tubing. 11. Rubber tubing.

Suction is provided by a glass laboratory suction pump (2) which works from the main water supply. This is connected by a rubber tube (10) through a trap-bottle (4) to a needle or catheter (6) which lies in the pleural cavity. The direct suction from such a pump is too great for safe use and it is essential to incorporate a suction relief device. This consists of a tall bottle (8) brought into circuit by a three-way connexion (3). The bottle is three parts filled with water and through a vaselined cork two glass tubes enter it. The short tube lies in the air space while the long tube (9) reaches below the surface of the water. When suction is applied this bottle (8) acts as a relief valve and the final suction transmitted to the pleural cavity will be dependent upon the depth of the tube (9) below the surface of the water. For example in the illustration where the tube reaches about three-quarters of the depth of the water, i.e. 15 cm., the residual suction will be almost exactly 15 cm. water column below atmospheric pressure. According to the length of the tube (9) below the water the suction can be varied over wide limits. So long as the suction provided by the pump (2) is greater than the submerged length of tube (9) air will bubble through the tube to provide the required pressure relief. Should greater suction be temporarily required for the evacuation of fluids, this can be obtained by clamping the rubber tubing (11) immediately above the bottle (8) thus eliminating the suction relief device.

This improvisation has proved very satisfactory in practice and the one disadvantage, the noise made by the water escaping from the suction pump, can be overcome if a further length of rubber tubing is attached to the pump outflow and the water allowed to discharge some distance away.

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A SUGGESTED SIMPLIFICATION OF IN-PATIENT CLINICAL RECORDS

BY

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THE War Office must obtain Clinical Records for statistical and other purposes. These records must be prepared by the M.O.s actually doing the clinical work. The numbers of different forms to be filled in by the Ward M.O. is slowly increasing year by year and is tending to markedly reduce the amount of clinical work he can undertake compared with his equivalent in civilian life.

The Ward M.O. often feels that his reputation and that of the hospital is judged more on the paper work than by the standard of the care and attention given to the patients.

In addition the nature of the present paper work appears to the Ward M.O. wasteful in time, energy and paper and out of proportion to its value. The following are examples of some of the faults in the present system.

(i) Writing almost identical notes on three different forms, A.F.B. 178, A.F.B. 256a and A.F.I. 1244.

(ii) In the case of a new patient or a transfer from another hospital; the difficulty of extracting the previous history, investigations and treatment from a mass of illegibly written forms of different sizes and shapes.

(iii) The time lost in filing these different forms and the ease with which they may become mislaid.

I feel sure that the present system of paper work could be enormously simplified for M.O.s in charge of wards and at the same time be made much more efficient from the point of view of the War Office Records and the Regimental M.O.

All criticism is valueless unless it is constructive. Therefore the following is an outline of my plan:—

(1) No Army form for clinical notes in hospital will be used other than the A.F.I. 1220. The reception M.O. will make a few brief remarks on this form, i.e. provisional diagnosis and instructions to the ward. The ward M.O. will continue these notes, using several A.F.I. 1220 cards pinned together if necessary, as under the present system.

(2) When the ward M.O. wishes to discharge or transfer a patient he will go to the Divisional Office where a clerk will type three copies of a brief summary of the case direct from the M.O.'s dictation, with the aid of carbon papers. The first two copies will be on A.F.I. 1220 flimsies and the third copy on a A.F.I. 1220 card.

The brief summary will be typed under the following headings:—

(i) *Diagnosis* in the usual place.

(ii) A brief *History*.

(iii) A brief summary of the *positive findings*, i.e. physical exam, X-rays, laboratory findings, etc.

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(iv) A brief summary of the *treatment* given, i.e. operations, etc.
(v) Briefly *his present condition.*
(vi) *Prognosis,* especially noting whether it is likely to interfere with his future efficiency as a soldier.
(vii) *Recommendation,* i.e. return to unit or convalescent depot, suggested category, general suggestions of after treatment to unit M.O., etc.
(viii) M.O.'s signature and typed name, rank, and appointment. When signed by a specialist it will therefore act as a specialist's report.

(3) The A.F.I. 1220 card (third typed copy) will be attached to the usual written A.F.I. 1220 and both despatched to the War Office. It will obviously be a much more readable document and in addition better for photostatic work than is the case at present.

(4) The first A.F.I. 1220 flimsy will be kept by the hospital in lieu of the A.F.I. 1224. Particulars such as the next of kin on the present A.F.I. 1244 are not necessary as already recorded on the other documents by the Reception Clerk and Sister in charge of the ward.

(5) The second A.F.I. 1220 flimsy will leave the hospital with the patient in a R.A.F. A.F.I. 1220 type of envelope in lieu A.F.B. 256a, and A.F.B. 178, for retention by the unit.

In my opinion the following advantages would accrue from the above system:—

The records received by the War Office, Regimental M.O. and Ministry of Pensions, etc., would be much better than is the case at present.

(2) The amount of clinical work that could be undertaken by the individual M.O. would be increased.

(3) The clerical work of each hospital would be simplified.

(4) More rapid discharge of patients from hospital, e.g. a very busy or tired M.O. will often be willing to dictate notes whereas if he had to write them by hand on four separate forms he would tend to put it off until the next day.

(5) Much greater speed in dealing with convoys and other sudden admissions of large numbers of patients to hospital. They would arrive with concise typewritten notes on one form instead of an untidy package of many illegible forms of different sizes.

(6) Reduction in War Office printing costs.

(7) Rapid and simple filing of patients' documents on the wards.

(8) A lost record could be easily replaced as two other identical copies are in existence.

(9) The standard of clerks would be improved, i.e. personal dictation from M.O.s would improve their knowledge and spelling of medical terms.

I wish to thank the following officers for their helpful criticism: Colonel W. M. Cameron, *C.B.E.*, my Commanding Officer, and Lieut.-Colonel A. G. D. Whyte, *O.B.E.,* Majors P. J. Collard and P. Seelig, Captain H. F. Page, Lieut. H. Howell-Jones.

[A Committee consisting of representatives of the Royal Navy, the Army and the Royal Air Force is considering the question of the adoption of a system of medical documentation which could be common to all three Services using as a basis of this new system, the present method of medical documentation in use in the Royal Air Force.—ED.]

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Journal
of the
Royal Army Medical Corps.

Original Communications.

THE EARLY DAYS OF ARMY PSYCHIATRY.

BY

Lieutenant-Colonel R. ROSIE.
Royal Army Medical Corps.

As far back as 1711 the necessity of caring for the insane soldier was recognized in Ireland and in that year the Royal Hospital at Kilmainham was enlarged for the reception of men quartered in Ireland who might be afflicted with mental derangement. The accommodation was limited and was enlarged in 1730 and again in 1807, when it proved capable of accommodating all cases arising in Ireland. It continued in use until 1849 when it was closed and patients were transferred to the military asylum in England.

In England, prior to 1819, the insane soldier patient excited little interest and such cases as were admitted to military hospitals received but scant attention in annual reports. In the annual report of the General Hospital, Fort Pitt, Chatham, for the year 1816 several maniacal cases are described. One is reported to have shown "an outrageous disposition particularly observable at the full and changes of the moon." Two were considered by their physician to be malingering and feigning insanity. He writes in his annual report: "Mania is not infrequently a mask for their consummate hypocrisy, as a soldier's word, which indeed can seldom be trusted, is obliged to be the foundation for his treatment in a material degree. It is certainly much to be regretted that there should be such an evident propensity on the part of a soldier to deceive his superiors with a mistaken view of forwarding his own future interest." No disciplinary action was taken against these two malingerers of 1816. They were returned to duty and were more fortunate than the unlucky private soldier who was believed in 1866 to be feigning insanity after an award of 168 days' imprisonment for attempted theft. Charged with feigning insanity he was again tried by Court Martial and awarded 18 months' hard labour and 50 lashes. It was reported that many who saw him believed him to be insane and that even the very drummers who flogged him had themselves later to be punished for the too obvious expression of their compassion.

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Prior to 1819 cases of mental disorder in the army in England were generally sent to one of the civilian asylums in the neighbourhood of London. The majority were received into the large asylum at Horton. Here, they were kept at a regular contract price and, as was established by a Committee of the House of Commons appointed in 1815 to investigate the conditions in "mad houses" in England, their care and comfort were matters of secondary consideration. Many instances of harsh treatment of patients were brought to light by this committee whose report makes grim reading. Mr. James Sharpe, surgeon and apothecary to Horton Asylum, stated to the committee that cases of violent insanity were confined by handcuffs and by chains to one or to both legs with a chain passing from the handcuffs to another connecting both legs at the ankles. When in bed the arms were put through large rings fixed in the crib. The case of a patient called Norris was investigated by the committee. The apparatus designed for his confinement was complicated. A chain passed from an iron collar, which encircled the neck, to an upright bar behind his head. An open-work iron frame encircled his body with apertures for the arms which were again encircled and confined at the elbows. From the ankles chains passed to the foot of the bed to restrain kicking. Norris was confined in these irons for nine years and they were never removed during that time. He died of a decline at the age of 57 and his physician was pleased to record that he had been released from this confinement some three weeks before his death.

It may be of some interest to describe briefly the care and treatment of the insane during the first two decades of the nineteenth century. Mental disorders were then divided into mania and melancholia. The causes could, it was considered, never be satisfactorily determined though many authorities made an attempt to do so by dividing them into physical and moral. Under physical causes were included repeated intoxication, blows on the head, fever, mercury and the suppression of periodic dicharges. Important moral causes were believed to be long endurance of grief, ardent and ungratified desires, religious terror, fits of anger and prosperity humbled by misfortune. The old belief that the insane were influenced by the changes of the moon continued to prevail. While foremost alienists of the period, however, placed little faith in this planetary influence, the more ignorant frequently had recourse to a severe coercion at the change of the moon. The master of one workhouse was accustomed, without waiting for any display of increased turbulence among his patients, to chain and flog his unfortunate inmates as he discovered the age of the moon by his almanac. In spite of the dreadful treatment meted out to many patients the English of this period seem to have acquired in Europe the credit for a superior treatment of the insane. Haslam, apothecary to Bethlem Hospital, quotes Pinel as saying: "Is it from a peculiar national pride, and to display their superiority over other nations, that the English boast of their ability in curing madness by moral remedies; and at the same time conceal the cunning of this art under an impenetrable veil?"

If anything could add to the calamity of mental derangement of this period it was the mode generally adopted for its cure. The office of attendant

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or keeper in establishments for the insane was held as a degrading and odious employment and seldom accepted but by idle and disorderly persons.

In the violent stage of mania it was advised that the patient be kept alone in a dark room, hands properly secured by iron manacles and confined by one leg. Some high medical authorities recommended the infliction of corporal punishment upon maniacs with a view to rendering them rational by impressing terror. The Bible, however, also countenances the use of mechanical measures to control violence (Jeremiah xxix, 26): "For every man that is mad, and maketh himself a prophet, that thou shouldest put him in prison and in the stocks." In many private establishments the practice of tying a towel round the mouth of a noisy patient was common. The procedure was aptly known as muffling. The circulating swing was by many regarded as a safe and a very satisfactory remedy for effecting a diminution in the case of maniacal excitement. The procedure was elegantly described by one writer as mechanical exercise. The patient was strapped in the machine and revolved up to a maximum of 110 revolutions per minute, which in most cases resulted in sudden action of the stomach, bowels and urinary passages being excited in quick succession, particularly if the motion of the swing was reversed every six minutes. With the patient in the erect position care was required to prevent the hanging over of the head, otherwise the suffusion of the countenance was found to leave an ecchymosis. If no evacuation occurred the patient became in any case so subservient to his physician's wishes as willingly to take any medicine prescribed. The full effect of the swing was calculated to produce a remarkable prostration of strength to the relief of all concerned, except perhaps the patient.

The ordinary medical remedies were bleeding, vomiting, and purging. Bleeding was believed to be of definite benefit. Crowther, surgeon to Bethlem, describes how the curable patients in Bethlem were bled about the beginning of June and at the end of July; 6 to 18 ounces of blood were withdrawn by venesection or preferably by wet cupping the scalp. Treatment by vomits was by no means considered to be the order of the day but many eminent alienists believed that the enormous quantity of phlegm with which the patients were supposed to abound could not the better be got rid of than by repeated vomits. Tartrate of antimony in from one to two grain doses was the emetic commonly employed. Crowther describes a case of melancholia who did not scruple to take 61 vomits from October to the following April and for 18 nights successively by which a large quantity of phlegm was got rid of and a perfect recovery resulted. As a rule, however, treatment by vomits was restricted to the spring and summer months, most hospitals being excessively cold in winter. Blisters to the head, shoulders, and calves had a certain vogue though it must have been a difficult matter to prevail upon maniacal patients to permit of such treatment. Digitalis was occasionally given and found useful in furious mania.

To convey food and medicine into the stomachs of refractory patients, an instrument resembling a teapot in shape, and termed a "spouting boat," was used. The procedure of forcible feeding involved securing the patient on his

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back, holding a cloth over the mouth, and forcing the spout between the teeth. The patient had of necessity either to swallow or die. Haslam writes: "It is a painful recollection to refer to the number of interesting females I have seen, who, after having suffered a temporary disarrangement of mind, and undergone the brutal operation of spouting in private receptacles for the insane, are restored to their friends without a front tooth in either jaw." They were lucky if the posterior portion of the throat was not also injured.

However, with it all, as a result of or in spite of treatment, a fair proportion of cases recovered. Haslam writes that in the ten-year period between 1784 and 1794, 488 patients between the ages of 20 and 30 were admitted to Bethlem, and 200 of them were discharged cured during this period.

Following disclosure of the harsh treatment undergone by patients in civilian asylums the Medical Department of the Army decided to establish a distinct military hospital for the treatment of the insane soldier, and Fort Clarence, situated near the large General Hospital, Fort Pitt, Chatham, was converted into a military lunatic asylum, and opened in 1819. Four officers, sixty-two soldiers and two women were admitted that year. Though a military fort was certainly not the most desirable building out of which to form a hospital it was a great improvement on the older method of dealing with the military lunatic and in the early days was stated to have made a most comfortable asylum. A painting of the hospital by one of the patients in 1820 shows it to have had a grim exterior, though no doubt it compared favourably in this respect with most of the civilian asylums of the time. Dr. Scott, Surgeon to the Forces, in his annual report for 1833 describes the hospital as elevated and overlooking the river Medway. He writes: "The prospect is exceedingly beautiful and picturesque and the eye of the melancholic may rest on it with relief and the intense emotions in the mind of the confirmed visionary, for a time perhaps be suspended."

Staff Surgeon Murray, the first physician in charge, seems to have displayed a remarkable efficiency which is worthy of note. Many authorities at this period paid great attention to the shape and size of the head but Murray believed that other portions of the body and external circumstances and difficulties were equally important and emphasized the purely temporary alienation of the senses in drunkenness without any disorder of the head. When discussing treatment in his annual report for 1820 he writes: "It is too commonly the practice when a patient is discovered to be insane to resort without discrimination to bleeding, blistering, setons, dark dungeons, and painful and degrading coercion which will often exasperate and cause disease to become incurable which might have been cured by appropriate treatment. Much general good is done by a strict attention to the regular exercise and amusement of the patients, by keeping up the previous military discipline and habits as much as possible and by adopting a system of rewards and punishment chiefly in the distribution of tobacco of which they are extravagantly fond. The good effects of this humane management are remarked on by visitors who enquired where the unruly were kept, but none were under coercion and for many days in succession no instrument of restraint was used."

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In 1821 10 officers, 33 soldiers, and 4 women were admitted, and a total of 18 were discharged as cured. The 47 admissions were classified as, melancholia 6, mania 20, imbecilitas 19, and dementia 2. Those discharged cured were sent to their depots for a month on probation before rejoining their units. Staff Surgeon Murray in his report for 1821 writes: "The minutest attention to the moral management of the patients continues to form the principal feature in the practice of the asylum. The patients are required to rise early, make their own beds, wash and clean themselves and then play at ball, marbles, or be exercised at the dumb-bell. Three times a day the majority are regularly marched to the extremity of the grounds to the sound of the clarinet. The officer patients amuse themselves with quoits, ninepins, cards, or backgammon, and are supplied with a daily newspaper which is afterwards passed on to the men." He draws attention to the remarkable fact that in this establishment of between 80 and 90 cases of insanity complicated with epilepsy, palsy, and other bodily diseases, only one death occurred during the year—a fact justly to be proud of in those early days when asylum mortality was high. Even as late as 1852 one finds the opinion expressed in the annual report of the military asylum: "The cures are a satisfactory number but the chief test of all asylums ought to be the mortality. The word 'cured' may be somewhat indefinite but about 'dead' there can be no mistake."

In the annual report for 1824 the value of occupational therapy was stressed. The physician in charge was an enthusiastic gardener, had planted at his own expense 200 trees, using seaweed manure, and the asylum gardens were able to supply the adjacent large general hospital at Fort Pitt with vegetables for the greater part of the year. The views expressed in the annual report for that year on the value of occupation and on the humane management of patients read as if written for our guidance to-day instead of well over one century ago. The physician writes: "The effect of labour on the unsocial feelings of the maniacal cases was instructive. It linked them in one common chain in which they are insensibly drawn together, granting assistance to each other and conversing on the nature of their work. There are few persons however afflicted with insanity or so entirely bereft of reason as not to be able to distinguish and in some cases appreciate kind treatment. Firmness of conduct and decision are ingredients absolutely necessary but these should always be blended with kindness and humanity. This is the principle on which I work and which I have inculcated upon the minds of attendants." He noted then, and we may similarly note to-day, that there is unfortunately less disposition among the officer patients to any form of bodily exertion than among the men.

Sir Andrew Halliday in a report to Lord Robert Seymour dated 1829 gives a short description of Fort Clarence. He writes: "Nowhere have the effects of medical science and the sound common sense principles of moral management been more successful than at Fort Clarence. The cures in this military asylum were, taking all things into consideration, the equal of any public or private establishment in the empire." 122 patients were resident in Fort Clarence at the time of this report. During the ten-year period 1819 to 1829, admissions

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totalled 334; 133 were discharged cured and 115 remained in hospital at the end of this period.

In succeeding annual reports the value of occupation for the patients and insistence on humane management were stressed Dr. Scott, Surgeon to the Forces, in his annual report for 1833 writes: "The attendants are enjoined to treat the inmates with consideration and kindness. They must be treated like children with gentleness and constant watching." Medical treatment in 1833 remained similar to that given in 1819. Local bleeding and cupping were extensively used, and setons and blisters were found to be useful auxiliaries. Tartrate of antimony proved a valuable and powerful remedy for checking the clamorous and repressing any tendency to violence. The shower bath was on occasion resorted to both as a curative measure and as a preventive of irregularities. The application of restraint was stated to be conducted in the usual temperate measures customary in the asylum. Regular exercise was enjoined. the patients were kept in a state of military discipline, fell in on parade, marched through the grounds, and on occasion were put through some military evolutions.

By 1833 many of the inmates had been long resident, some from as far back as 1819, and eight deaths from pulmonary tuberculosis occurred. The military psychiatrist then encountered at least one problem still existent to-day. In his annual report for 1832 Dr. Scott mentions a case of simulated epilepsy on the part of one Maurice Sullivan, a compound of "vice with apparent innocence." He writes: "This babe of grace addressed me in words calculated to excite commiseration. He expressed apprehension that he should fall in the fire during a fit. So Maurice was confined to his bed in order to keep him away from the fire, and placed on a class of diet not above par. It alternated between cow and spoon together with a medicated draught administered thrice a day. compounded of aloes and antimony tartrate. In the course of a few days Maurice began to recover and on 25th September this lamb said he was quite well and fit to do his duty. He was consequently discharged and has not been in this hospital since."

In the annual report for 1840 occurs the first mention of the suicide of a patient. In the words of the report: "He stealed away down a dark passage and hanged himself in a bathroom." When discussing the staff the physician writes: "The married attendant is commonly necessitous and must have much firmness of principle to resist such opportunities as afford in the asylum to appropriate to the use of his family articles of food. Moreover, the single men are more easily kept at their posts. They ask for less leave, and are satisfied with more confinement. I apprehend it might be an advisable rule to establish as part of the Standing Orders that no married soldier should be taken on as an orderly." Such pleasing features of the unmarried attendant are unfortunately less in evidence to-day. His recommendation, however, apparently was not put into effect. A few years later the storekeeper, an old servant of the institution, finding some deficiencies in his stores, put an end to his existence by cutting his throat in the presence of one of his children.

In 1846, on the advice of His Majesty's Commissioners in Lunacy, who had

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always shown a warm sympathy for the welfare of Fort Clarence, it ceased to be a military asylum. Owing to the increasing number of patients it had become impossible to arrange for proper segregation of the different types of case and the building with its gloomy chambers, long dreary passages and irremediable dampness was not the best calculated to produce cheerfulness and activity. The patients were removed to the Royal Naval Hospital at Great Yarmouth which had been specially re-modelled for the purpose. This was a comfortable and commodious asylum and the humane management which had been carried out at Fort Clarence was continued. By 1854 all instruments of restraint had been withdrawn except the strait waistcoat which was, however, rarely used, and the iron guards which had defended the windows on the first fitting up of the asylum had been removed. There followed a great diminution in the number of panes of glass broken and no disposition to a mischievous destruction as had formerly been the case. The inmates were permitted considerable freedom and several officers and men were allowed to attend public lectures, etc., in the town. An aviary was fitted up in the officers' day room and kept well stocked with canary birds. Morning prayers were read in the hospital chapel by the physician in charge at 9 a.m. in summer and 9.30 a.m. in winter.

In 1854 the Admiralty decided that it was necessary to use the Military Asylum at Great Yarmouth for the reception of wounded sailors who were at the time expected to arrive in great numbers from the Baltic Fleet. The hospital closed down in that year, the officer patients being removed to Coton Hill civil asylum and the soldiers and women to Grove Hall asylum, Bow. With the closing down of the military asylum at Yarmouth no public provision existed for the insane soldier with the exception of some inadequate accommodation set aside for this purpose in the general hospital at Fort Pitt, which His Majesty's Commissioners in Lunacy in their annual report for 1854 describe as gloomy, damp, and unfit for the reception of patients. In 1855 a building capable of accommodating between 40 and 50 patients was erected at Fort Pitt as a temporary measure. In the same year the subject was raised in the House of Commons and it was finally decided to provide a new military asylum at Netley. Pending completion of this, the temporary building at Fort Pitt was to continue in use. Much too small to cope with the admissions which in the year 1861 numbered 289, patients were required after a short stay to be either discharged to duty, to care of friends, or transferred to Grove Hall Asylum, Bow, a metropolitan licensed house. At the latter hospital they appeared to have stagnated; many were described as disorderly and with dangerous propensities which required their being kept in single rooms during the visits of their medical officers. His Majesty's Commissioners in Lunacy continued to take a keen interest in the welfare of the insane soldier and in the year 1858 expressed great dissatisfaction with the accommodation provided and hoped that amid the general sympathy and attention lately awakened to the condition of the soldier, the absence of all proper provision for mental disorder would not be overlooked.

In 1866 the erection of the new military asylum was commenced at Netley

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and the building was ready for occupation in 1870. Though the building at first did not appear to be entirely satisfactory and a case of severe frost-bite occurred in a melancholic patient, the patients then enjoyed certain luxuries not now general. The Commissioners in Lunacy report in 1870: "We observe that they have to drink their porter out of quart basins and we beg to recommend that pint mugs be substituted."

The early days of army psychiatry are thus more distant than many to-day are aware of, and the modern army psychiatrist will find little to be ashamed of in the treatment meted out by his predecessors to the insane soldier more than one century ago. On the contrary, I think he might find the annual reports of Fort Clarence, with their insistence on the value of occupation and humane discipline, would repay perusal. Military accommodation set aside in 1819 for the insane soldier was reasonably generous and patients were then, though unfortunately the policy was later changed, allowed to receive the benefit of a prolonged stay in a military asylum where the humane care and management could at least compare favourably with any civilian asylum in the country. These humane methods of management were indeed in advance of what are regarded as the epoch-making innovations of Dr. Gardiner Hill at Lincoln and Dr. Connolly at Hanwell.

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THE PATHOLOGY OF THE LIVER IN DEATHS FROM THERMAL BURNS.

BY

Major A. P. PRIOR,

Royal Army Medical Corps.

Late Specialist in Army Pathology.

[*Received December* 30, 1947.]

THE older descriptions of the visceral pathology of burned patients were prodigal not only of the variety of pictures seen but of theories to account for these changes (Pack, 1926; Hankins, 1942). More recent studies have denied the presence of specific cellular lesion in burns (Cameron, 1945, 1946; Gibson, 1945). This paper gives an account of some of the lesions seen in the livers of thermal burns cases and an attempt is made to correlate them with the therapy given. On this basis it would appear that the actual microscopical change in these livers is a reflection of the agent applied therapeutically. The type of treatment common to all cases was the administration of large amounts of fluid intravenously. This will obviously have effect on the amount of congestion seen and on pigment metabolism (Brown, 1946), and will thus be common in some degree to each section studied.

MATERIAL STUDIED.

The livers of 35 cases of deaths from thermal burns in male adults aged from 20 to 33 years have been studied. The cases have been divided in accordance with local treatment administered.

Group I.—Cases who received anticoagulants—tannic acid and such like.

Group II.—Cases who received bland treatment principally saline and saline baths.

Group III.—Cases who received sulphonamides with or without other topical treatment.

The times of survival after burning varied from instantaneous incineration up to seven hundred hours. More than half the deaths occurred less than one hundred and twenty hours after the injury. Of these, half occurred in the first forty-eight hours. Post-mortems were usually done ten to twelve hours after death.

The causes of the burning were airplane crashes, explosions of petrol tanks of cars, primus and petrol cooker accidents, tents catching fire and other forms of accident associated with military service. All were admitted as thermal injuries. No cases of chemical burning as by mustard gas or phosphorus were seen.

The burnt area was always carefully inspected. The extent and depth of

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the burn were estimated according to established rules. The estimation of the depth in three degrees is useful in the general assessment of the case and for the extent the method of Berkows (1924) is fairly just.

Cases Treated with Tannic Acid or its Preparations.

Three cases were treated with tannic acid alone, two with tannic acid and silver nitrate and a further six received mixed tanning and sulphonamides. These six will be considered later.

Table I.—Coagulants.
Tannic Acid Alone

Case	*Survival time in hours*	*Treatment*	*Time to post-mortem in hours*	*Percentage of body surface burnt*
Case I	72	Tannic acid	4	60
Case II	84	Tannafax	9	65
Case III	144	Tannafax and saline	11	65

These three had been due to explosions of petrol.

The livers were of normal size but rather more flabby than natural. Otherwise they showed nothing of note in thus conforming with various descriptions given by Wilson and his associates for the one hundred hours' period.

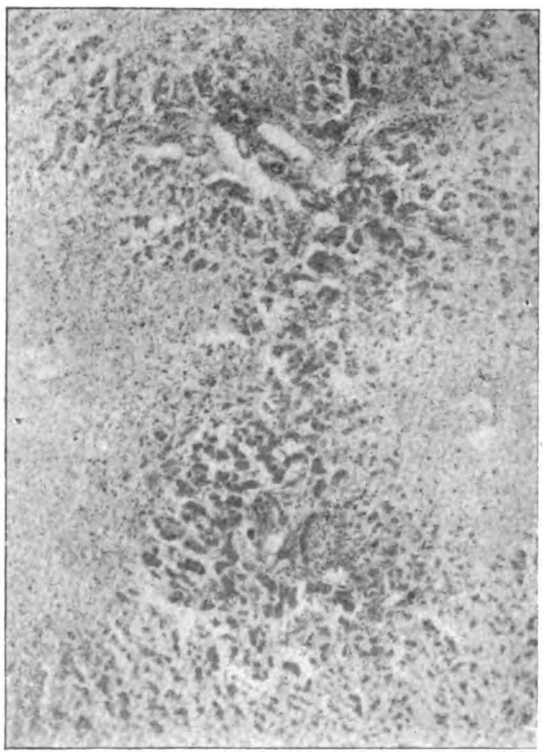

Fig. 1.—Central necrosis of lobules in a case treated with tannic acid. × 60.

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TABLE II.—COAGULANTS.

Cases Treated with Tannic Acid and Silver Nitrate

Case	*Survival time in hours*	*Treatment*	*Time to post-mortem in hours*	*Percentage of body surface burnt*
Case IV	12	Tannic acid, silver nitrate	5	65
Case V	120	Tannic acid, silver nitrate	10	40

There was no evidence of suppuration in the burned areas. The physical condition was good but icterus was marked. The liver was of normal size but was soft and flabby. Its colouring varied in depth. On section the central veins of the lobules appeared to be dilated but the macroscopic anatomy could not otherwise be made out.

It will be seen that cases treated by tannic acid with or without other agents are macroscopically of the same kind though they differ in degree. This is further borne out by microscopy of tissues taken at the time. The subject of these histological appearances has been covered by Wilson *et al.* (1935, 1937, 1938), by Belt (1939) and more recently by McClure *et al.* (1944).

The changes in the liver in these cases listed in Tables I and II differ quite an amount in degree. That case which survived the least time (Case IV surviving twelve hours) showed cloudy swelling of the polyhedral cells together with congestion of the parenchyma. Cases surviving seventy hours and longer showed pronounced hepatic change.

This consisted essentially of the central necrosis of Wilson in degrees of severity depending on the length of time of survival. All of these cases showed the presence of eosinophils but none collected in the manner which he described. In no case were intracytoplasmic inclusion bodies found as described by Belt. Despite a careful search no evidence could be found of intranuclear inclusions. Fat stains did not reveal any stainable fat and there was no evidence of iron increase. The amount of cell necrosis was usually large. In the most advanced case there was a rim of single polyhedral cells at the periphery of the lobule and the nuclei of these were pyknotic. In general the shape of the lobule was preserved. There was no evidence of reaction in the portal tracts.

SALINE AND SALINE BATHS.

A series of 13 cases was encountered which received only bland treatment or no treatment to the burned area. Included in this series are two cases of incineration which received no treatment and one of mild burns which died of intercurrent cause.

Concerning the livers that were obtained as result of incineration there were no remarkable changes. Their histological picture was normal.

LOCAL APPLICATION OF SULPHONAMIDES WITH OR WITHOUT OTHER TOPICAL MEASURES.

A series of 15 cases was treated in the main with local application of sulphonamides (Tables IV and V). To these were added on occasion, tannic acid, tannafax, silver nitrate, triple dye, acriflavine, sodium bicarbonate and sodium

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chloride in varying admixtures to various cases. Nine of the cases were treated locally by sulphonamides alone.

TABLE III.—BLAND.

Cases Treated Principally with Saline and Saline Baths

Case	*Survival time in hours*	*Treatment*	*Time to post-mortem in hours*	*Percentage of body surface burnt*
Case VI	6	Nil	—	70
Case VII	6	Nil	—	70
Case VIII	8	Plasma intravenously	10	80
Case IX	15	Nil	2	19
Case X	24	Saline dressings. Picric acid	20	55
Case XI	48	Saline dressings. Vaseline	10	68
Case XII	48	Acriflavine saline	15	40
Case XIII	104	Saline baths	10	40
Case XIV	120	Saline baths	23	50
Case XV	144	Saline baths	5	60
Case XVI	170	Vaseline gauze	10	30
Case XVII	240	Dettol, flavine, paraffin	9	60
Case XVIII	744	Saline dressings	6	15

Two cases of incineration not included in table.

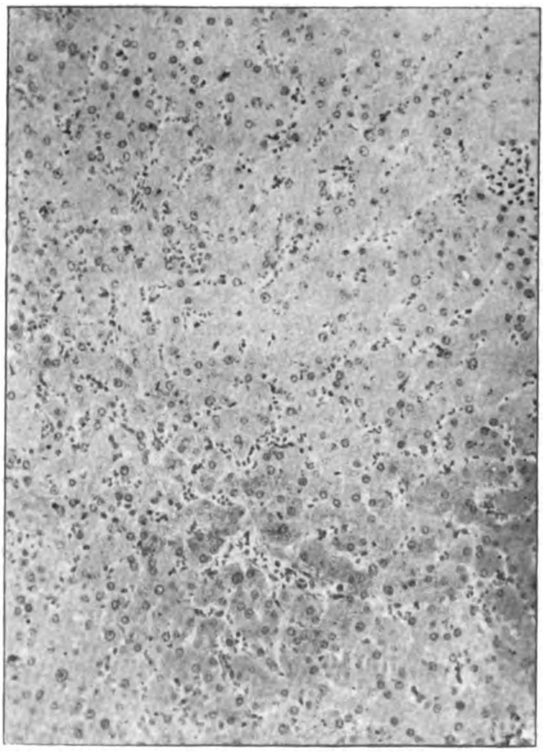

FIG. 2.—Liver from case receiving only bland treatment. × 150.

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I propose to deal first with those cases which received the classic sulphonamide-vaseline gauze treatment, and later with those cases which had any more mixed forms of treatment.

TABLE IV.—SULPHONAMIDES.

Case	Survival time in hours	Treatment	Time to post-mortem in hours	Percentage of body surface burnt
Case XIX	12	Sulphaguanidine. Vaseline gauze	10	70
Case XX	48	Sulphanilamide. Vaseline gauze	10	50
Case XXI	48	Sulphanilamide. Vaseline gauze	10	50
Case XXII	72	Sulphanilamide. Vaseline gauze	14	50
Case XXIII	96	Sulphonamide. Vaseline gauze	—	70
Case XXIV	172	Sulphonamide. Vaseline gauze	4	60
Case XXV	312	Sulphonamide. Vaseline gauze	10	30
Case XXVI	312	Sulphonamide. Vaseline gauze	10	30
Case XXVII	360	Sulphonamide. Vaseline gauze	10	60

Case XX sustained second and third degree burns of 50 per cent of the body surface. He was dressed with sulphonamide and vaseline gauze. Blood sulphonamide was 40 mgm. per cent a little later. Rectal salines and sedatives were continued but the patient died forty-eight hours after the injury.

Post-mortem was done eleven hours after death. The liver was of normal size with a clear glistening capsule. It was greasy to the touch and areas of fatty change were evident from the surface. On section fatty change was widespread. Many areas showed disarrangement of the normal architecture. Histo-

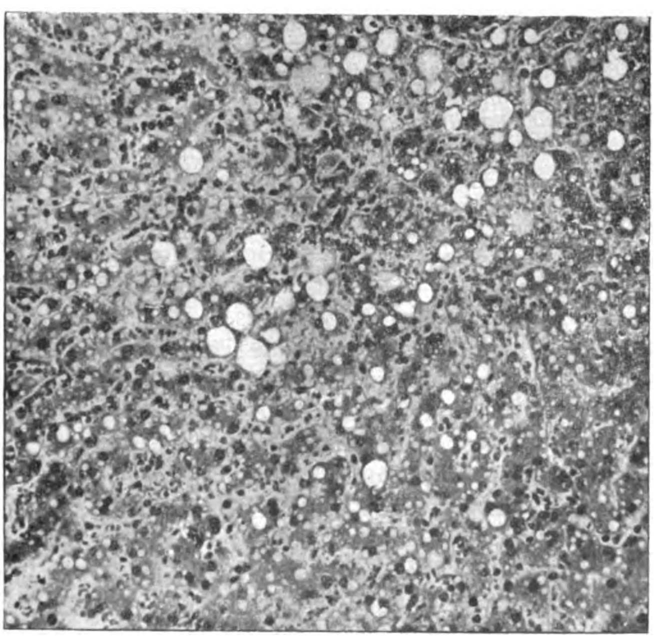

FIG. 3.—Liver from Case XXV. Sulphonamide treatment. × 200.

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logically pronounced changes were found in the liver. The portal tracts were within normal limits. The central veins of the lobules were much dilated. The whole organ was much congested. Diffuse vacuolation was present in the polyhedral cells, displacing the nucleus and expanding the cell. Fat stains showed that these cells contained large drops of fat which stained with Scharlach R. The main incidence was at the periphery of the lobule but it was essentially diffuse.

The remaining cases of this group all confirmed these histological findings.

Two cases died in the period 50–100 hours. Both were battle casualties. Case XXII received second and third degree burns for 50 per cent of the body surface. He was treated with sulphonamide-vaseline gauze.

Post-mortem was done fourteen hours after death. The liver showed diffuse fatty changes. On section the macroscopic appearances were confirmed. The fatty degeneration of the liver was extensive.

TABLE V.

CASES TREATED WITH SULPHONAMIDES TOGETHER WITH OTHER LOCAL APPLICATIONS

Case	*Survival time in hours*	*Treatment*	*Time to post-mortem in hours*	*Percentage of body surface burnt*
Case XXVIII	72	Sulphonamide - vaseline gauze, tannic acid, acriflavine	10	65
Case XXIX	96	Sulphonamide - vaseline gauze, triple dye	10	70
Case XXX	120	Sulphonamide - vaseline gauze, triple dye, silver tan	19	60
Case XXXI	144	Sulphonamide - vaseline gauze, acriflavine, tannic acid	10	40
Case XXXII	240	Sulphonamide-vaseline cellophane tannafax	10	30
Case XXXIII	360	Sulphonamide - vaseline gauze, tannic acid, acriflavine, triple dye	19	20

Case XXIX survived ninety-six hours after receiving second and third degree burns for 70 per cent of the body surface. He was treated with triple dye and sulphonamide vaseline gauze. He pursued a slow course of gradual dissolution. At post-mortem the liver showed fatty changes.

Case XXXIII survived three hundred and sixty hours after 20 per cent of the body surface had been burnt. Treatment included sulphonamide-vaseline gauze, tannic acid, acriflavine and triple dye. The burns became grossly infected, œdema was marked and the general course was stormy. Signs of pneumonic consolidation developed. Jaundice was noted.

At post-mortem, acute suppurative pericarditis and broncho-pneumonia were present. On section in addition to these changes there was congestion of the liver with cloudy swelling of the polyhedral cells. The central lobular veins were dilated and near this there was often a rim of necrosed cells. There was no evidence of fatty change. Nor was any evidence found of cell inclusions or of eosinophilic infiltration.

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Discussion.

A variety of cellular lesions have been described as resulting from thermal burns. Of these the majority of authors place most emphasis on the liver (Wilson *et al.* (1937 and 1938), Henkins (1942), Boyce (1941 and 1942)). Central lobular necrosis was described by Wilson (Wilson *et al.*, 1938) as resulting from the burning and by Wells *et al.* (1942), Hartman and Romence (1943), Lee and Rhoades (1944), Barker and Handler (1943), Erb, Morgan and Farmer (1943), who all ascribe the necrosis to the coagulating agent.

Belt (1939) observed intra-cytoplasmic and intra-nuclear inclusion bodies in the livers of tannic acid treated cases. This I was unable to confirm. The technical methods were controlled by putting through yellow fever material at the same time.

The observations of Erb *et al.* (1943) that no central lobular necrosis occurred in the untanned cases is confirmed.

The saline-treated cases showed only cloudy swelling and some extravasated red blood cells.

The cases treated with sulphonamides were in marked contrast. These showed widespread fatty degeneration. Somewhat the same appearances were noted by Gibson (1945). The fatty degeneration in these cases seems to have been more pronounced. The absence of such change in cases from the other treatment groups who survived longer and were in worse nutritional state tends to exclude the possibility of starvation as a cause of this marked and generalized fatty degeneration.

The possibility of the liberation of a specific substance from a burned surface has been widely canvassed and receives experimental support, notably from Peters (1945) and Kellaway and Rawlinson (1944). In the actual series under review the therapeutic agent gave a profound recognizable effect in the liver.

Summary.

Cellular changes observed in the livers of 35 cases dying from thermal burns could be coupled with the topical therapy.

Those treated with tannic acid showed central lobular necrosis. Intra-nuclear and intra-cytoplasmic inclusions were not found.

Those treated with sulphonamides showed fatty degeneration.

No specific changes were found in those who received only bland treatment.

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DIPHTHERIA IN THE ARMY IN THE UNITED KINGDOM. A STUDY OF ITS COMPLICATIONS.

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During the recent war diphtheria was one of the most prevalent infectious diseases affecting British troops. The severity of the disease, its comparatively high fatality rate and its numerous complications warrant further studies of its clinical features as manifested in an entirely adult population. It is commonly accepted not only that diphtheria is far less common in adults than in children but also that the disease runs a far less serious course with fewer complications. Thus, Rolleston and Ronaldson (1940) found in their vast experience that case fatality rate decreases with increasing age of patient. It is, therefore, of interest to observe that the fatality among 534 cases of diphtheria occurring in 1944 among British troops stationed in the United Kingdom was 2·4 per cent; a figure which is not unduly low in comparison with civilian fatality as observed by Rolleston and Ronaldson (1940). They state that the present-day fatality of diphtheria in London Fever Hospitals rarely exceeds 5 per cent.

The complications of diphtheria are, for the most part, due to the action of the specific exo-toxin on various tissues of the body. The two systems most severely affected are the cardiovascular and nervous systems. Cardiac failure may occur early in the course of the disease due to peripheral vascular failure arising from severe toxæmia; or it may occur later as a result of damage to the cardiac muscle in which the conducting tissues of the heart are frequently affected. The neurological complications are numerous. Paralysis of the palate and of the muscles of ocular accommodation occur during the third and fourth weeks, whereas polyneuritis occurs much later, commonly during convalescence. This triad of pareses constitutes the classical neurological complications of diphtheria. Although other neurological complications may occur (e.g. paralysis of diaphragm, facial paralysis and laryngeal paralysis) they are uncommon. Nevertheless they share the characteristic of the classical pareses in that they appear to be due to lesions of peripheral rather than central nervous tissue. In this connexion it is pertinent to cite the conclusion of Friedemann

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and Elkeles (1934) that the exo-toxin of diphtheria is incapable of traversing the "blood-brain barrier."

Among the various neurological complications, polyneuritis is of particular importance from two points of view. First, it is a complication which usually supervenes during convalescence when the patient has already left hospital. Secondly, it was a common complication among Army patients and one which resulted in prolonged incapacity for work.

The main purpose of the present study is to examine the incidence of complications and their relationship to one another and to serum treatment.

Source of Data.

The present study is based on an analysis of case-records of 254 diphtheria patients admitted from units in United Kingdom to military and E.M.S. hospitals during the period January 1943 to August 1944. The Army documentary system provides excellent opportunities for studies of this nature. Hospital record cards are stored in a general medical file at War Office, and all case-records concerning a given individual are filed together. Information is therefore available with respect to late complications and sequelæ, a circumstance of particular value in the study of diphtheria because of the high incidence of polyneuritis often after a considerable lapse of time. Hence we are not faced with the same difficulty as Illingworth (1945) who, in a study of diphtheria among troops, remarks: "It is impossible to say how many developed polyneuritis, because the complication is frequently so late that it would not develop until the patient has proceeded to the Convalescent Depot."

Site of Infection.

In the present series, the following clinical varieties of diphtheria occurred:—

Faucial	=	96·5 per cent
Nasal (anterior rhinitis only)	=	2·8 per cent
Primary laryngeal	=	0·8 per cent

These figures conform closely to the findings of Rolleston and Ronaldson (1940) who found among 3,000 cases of diphtheria that the great majority were faucial infections, only 1·5 per cent being nasal (anterior rhinitis only) and 1·1 per cent primary laryngeal. It thus appears that the primary site of infection is the same in the adult Army population as it is in a mixed civilian population composed mainly of children. This finding is of some interest in relation to the observation of Rolleston (1916) that laryngeal diphtheria occurs much less frequently in adults than in children. Likewise Rolleston (1917) states that isolated nasal diphtheria (i.e. not occurring in association with faucial infection) is most frequent in young children, only 2 cases having been observed in adults.

Primary cutaneous diphtheria was uncommon among troops serving in the United Kingdom. In our present sample no such case occurred. This is in sharp contradistinction to the experience of troops serving in tropical and

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sub-tropical climates where cutaneous diphtheria has been prevalent (Cameron and Muír, 1942; Hunt, 1944).

The numbers of primary nasal and laryngeal infection in our present series are too small to yield any useful information. We are, therefore, left with a group of 245 patients with faucial infection for further examination.

Diphtheritic Membrane and Bacteriological Findings.

There are two outstanding diagnostic criteria in faucial diphtheria. They are, first, the presence of a well-defined diphtheritic membrane and, secondly, the presence of Klebs-Lœffler bacilli in the throat of an ill person. In this context, the term "well-defined membrane" connotes a lesion exhibiting the classical features of diphtheritic membrane; "no membrane" includes such non-specific lesions as exudate, œdema and tonsillitis. In the present series these diagnostic features occurred in the following proportions:—

With membrane and K.L.B.	=	51 per cent
With membrane only	=	22 per cent
With K.L.B. only	=	21 per cent
With neither membrane nor K.L.B.	=	3 per cent
Diagnostic criteria not recorded ...	=	3 per cent

It is conceivable that a number of the patients with no membrane and negative bacteriological findings were wrongly diagnosed. Even if this is so, their numbers are too small to influence our findings materially. It is possible, however, to assess the accuracy of diagnosis by studying the incidence of neurological complications characteristic of diphtheria among patients who present with or without a diphtheritic membrane and among those with or without positive bacteriological findings. Table I shows that patients *without* membrane experience these complications as frequently as do those *with* membrane; and likewise, patients with throat swabs negative for K.L.B. experience these complications as frequently as do those with positive throat swabs. Such differences as exist between these various classes of patient could be expected to occur frequently by chance.

Table I.

Incidence of Characteristic Neurological Complications in Relationship to :—
(a) Presence or Absence of Membrane.
(b) Positive or Negative Bacteriological Findings.

	% *with characteristic complication*	*Difference*
(*a*) *Membrane*—		
Present (178)	20·2	$0{\cdot}8 \pm 6{\cdot}0$
Absent (62)	21·0	
(*b*) *K.L.B.*—		
Positive (175)	16·6	$15{\cdot}5 \pm 9{\cdot}4$
Negative (28)	32·1	

It will be observed that these findings support the view that errors of diagnosis were not numerous. Furthermore they permit us to treat the whole

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series as clinically homogeneous with respect to chance of complications developing. The following results are therefore presented for the whole group of faucial cases without subdivision in relation to bacteriological findings and presence or absence of membrane.

Serum Treatment.

Anti-diphtheritic serum remains the most important therapeutic agent in treatment. It is universally agreed that serum must be given early in order to exert its maximum effect. Among the present series there are 158 patients for whom date of onset of symptoms and date of first injection of serum are both recorded. For the purpose of Table II, which summarizes the relevant data, early treatment signifies administration of serum during the first two days of the disease.

Table II.

Relation of Complication to Time of First Dose of Serum

First dose of serum	*Number of patients*	*% with complications*	*Difference*	*% with polyneuritis*	*Difference*
Early	81	18·5	6·2±6·4	6·2	10·7±5·1
Late	77	24·7		16·9	

Among cases receiving serum late in this sample, there is actually a greater proportion of patients with complications than among cases receiving serum early, but the difference is not statistically significant. If we take polyneuritis alone, the difference between cases receiving serum early and late is more clear-cut and is statistically significant. These results indicate that one of the main values of early treatment by serum *in an adult population* is the reduction of polyneuritis.

The total amount of serum administered is also a matter of importance. Table III shows the proportion of patients developing complications in relation to the total quantity of serum they received.

Table III.

Total dosage of serum in 1,000 units	*No. of patients*	*No. developing complications*	*% developing complications*
Up to 10	29	6	20·1
10–20	53	11	20·3
20–40	75	15	20·0
40–80	52	15	27·7
80+..	35	14	42·4

Casual consideration of these findings, which show that larger doses of serum are associated with a larger proportion of complications, might lead one to suspect that large doses of serum are not valuable. But it is accepted practice to give large doses of serum to the more severely ill patients, a circumstance in itself sufficient to explain an otherwise paradoxical result. Similar

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findings have been recorded, Bolton and Pivawer (1947) in their study of faucial diphtheria among troops in Belgium. They state: "Serum at first sight appears, if anything, to promote the development of neurological complications, but the fact that the more toxic cases received more serum probably accounts for the discrepancy."

Complications.

The following shows the proportion of cases with particular complications in our sample of 245.

	Per cent
Palatal paralysis	14·7
Polyneuritis	10·6
Paralysis of accommodation	5·7
Extrinsic ocular paralysis	1·2
Facial paralysis	0·4
Cardiac dysrhythmias (mainly persistent bradycardia, tachycardia and multiple extrasystoles)	4·8
Cardiac failure, late	1·2
Cardiac failure, early	0·4
Albuminuria, non-febrile	3·3
Otitis media	1·2
Pulmonary complications	1·2
Patients with one or more of the above complications	24·9

The one patient with early cardiac failure died. Two out of the three patients who developed late cardiac failure also died. Among the complications cited, it is probable that the figure for paralysis of accommodation is an underestimate because this complication manifests itself as a subjective change; but the error is likely to be smaller in this series of adults than in one containing many small children. Rolleston (1913) has pointed out that minor forms of paralysis, of which paralysis of accommodation is one, may be so mild as to escape attention.

Polyneuritis.

Perhaps the most striking feature of this particular complication is its late time of occurrence. Fig. 1, which sets out the percentage frequency-distribution of its time of onset, shows that approximately 65 per cent of cases occur forty to eighty days after day of admission to hospital.

Since all forms of paralysis in diphtheria are probably due to the same toxin, it is of interest to determine whether development of an early form of paralysis indicates liability to polyneuritis later. Examination of our data with respect to this possibility reveals that palatal paralysis is a valuable prognostic sign indicating a high risk of subsequent polyneuritis (Table IV).

Table IV.

Showing Prognostic Significance of Palatal Paralysis in Relation to Risk of Subsequent Polyneuritis

	% Incidence of polyneuritis	*Difference*
With palatal paralysis (36 cases) ..	44·4	39·6 ± 8·5
Without palatal paralysis (209 cases)	4·8	

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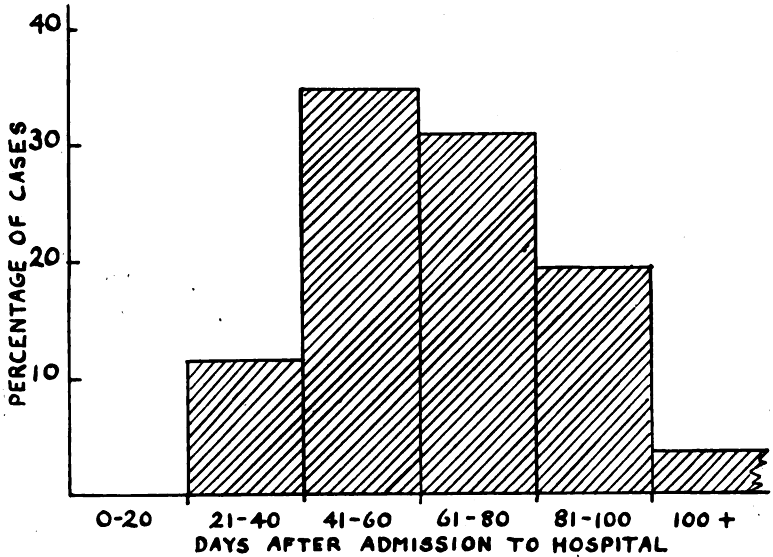

FIG. 1.—SHOWING PERCENTAGE FREQUENCY DISTRIBUTION OF TIME OF ONSET OF POLYNEURITIS

The practical importance of this finding emerges from the fact that many patients develop polyneuritis *after discharge* from hospital. Burkhardt *et al.* (1938) after study of electrocardiographic changes in diphtheria state that myocardial changes frequently accompany nerve palsies. They conclude: "When conditions do not favour the routine use of electrocardiograms the development of a nerve palsy should suggest the immediate need for special care———. Absolute bed rest and a prolonged convalescence should be demanded." On the evidence before us there are sufficient grounds for considering the desirability of retaining in hospital for at least eighty days those patients who develop palatal paralysis.

DISCUSSION.

A noteworthy finding of the present study is the prognostic significance of palatal paralysis with respect to liability to subsequent polyneuritis. This result is sufficiently clear-cut to make it probable that this relationship is a true feature of diphtheria. On the other hand, a search of the literature suggests that this close association is not widely appreciated, although it is true that certain authors infer that an association exists. The nearest approach to our conclusion has been put forward by Harris and Mitman (1947) in the following words: "Paralysis of the soft palate is the commonest and earliest. If the palate escapes, subsequent paralyses are extremely unlikely although occasionally the eyes are affected without the palate being involved." On the other hand we have not found any explicit statement of the magnitude of risk of subsequent polyneuritis. In the present series nearly a half of all patients who developed palatal paralysis subsequently developed polyneuritis. Previous

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failure to note this association is the more surprising since the various neurological complications are commonly assumed to be caused by the same exotoxin. In seeking an explanation for this failure, we must bear in mind the following possibilities:—

(*a*) That the clinical features of the sample here studied may differ from those of diphtheria as it affects a civilian population, where the heaviest incidence occurs among school-age children.

(*b*) That in civilian life, most patients leave the fever hospital before the time of maximum liability to polyneuritis. Those developing this complication are then more likely to be seen by a neurologist than by the fever hospital physician. In brief the difficulty confronting Illingworth (1945) in the Army may operate equally effectively in civilian life.

While we incline to the view that the second explanation is the more important, it is impossible to be dogmatic. The issue is one which demands an *ad hoc* inquiry for elucidation.

The finding just discussed in itself suggests that the process which leads eventually to manifest polyneuritis may be operative early in the course of the disease. This view is reinforced by the finding that patients receiving serum during the first two days of the disease were less prone to subsequent polyneuritis than patients receiving serum later (Table II). Here the finding is less clear-cut, since the difference between the two classes of patient is one which might occur as a chance finding about once in twenty times. However, if we accept the difference as significant, we must conclude that we have evidence to suggest: (*a*) That polyneuritis is directly due to presence of diphtheria exotoxin; (*b*) that the process which eventually leads to polyneuritis is in active progress during the first few days of diphtheria.

In this connexion it is of interest to note that Walshe (1918) regards polyneuritis as a blood-borne infection of the nervous system but attributes palatal paralysis to an ascending perineural lymphatic spread. It is difficult to reconcile this view with the great delay which occurs in the onset of polyneuritis. An alternative possibility is that all neurological manifestations are due to spread of the exotoxin from the nerve-endings up to the nerve-cells. Thus neurological symptoms would appear when the toxin reaches the nerve-cell and the time of onset of symptoms would therefore depend upon the length of the nerves concerned. Such an hypothesis explains both the close association between early palatal paralysis and late polyneuritis and the lower incidence of polyneuritis in patients receiving serum in the first two days of the disease. Unfortunately our data provide no evidence of value in pursuing the problem and it remains a matter for speculation and further study.

SUMMARY.

(1) In 1944 there were 534 cases of diphtheria admitted to military and E.M.S. hospitals from units in United Kingdom. The fatality rate was 2·4 per cent.

(2) Of 254 patients whose case-notes were analysed, 96·5 per cent were faucial

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infections, 2·8 per cent nasal and 0·8 per cent primary laryngeal. No cases of cutaneous diphtheria occurred in this series.

(3) Within the sample 24·9 per cent of patients suffered from complications, either single or multiple.

(4) Within the Army age-group the most clearly beneficial effect of *early* serum administration is to lower the incidence of polyneuritis.

(5) Of faucial cases 10·6 per cent developed polyneuritis. In two-thirds of them onset of symptoms occurred forty to eighty days after hospital admission.

(6) Palatal paralysis is a noteworthy prognostic sign indicating high risk of subsequent polyneuritis.

(7) Since onset of polyneuritis often occurs *after* hospital discharge and since there is evidence to suggest that it is associated with active cardiac lesions, prolongation of hospital treatment for cases with palatal paralysis is worthy of consideration.

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COLUMN INTO THE NAGA HILLS.

BY

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MANY hundreds of reconnaisance columns must have operated during the war, and little will ever be known of their activities. I can tell you of one only, but it will, perhaps, serve as an indication of the work involved in gaining information of the enemy and so ensuring some measure of success for our main forces.

The Naga Hills border the Indo-Burma Frontier and, in June 1944, were infested with Japs who were then still astride the Manipur Road. At that time the 20th Indian Division was forcing the Litan approaches to the Naga Hills, and guarding its left flank was the 153rd Gurkha Parachute Battn. in a series of Company positions along the hill feature running up to the Mung Ching. At Battalion H.Q., it was obvious that something was afoot, as we kept having strange visitors who would be closeted with the C.O. for a short time, and then depart. We didn't often have visitors, as H.Q. was on a feature over a thousand feet above the paddy, approached by a footpath which went almost straight up and was impassable to mules after heavy rain. A day or two later the C.O., Lt.-Col. Willis, called me out of our dugout mess to speak privately outside. He told me that our battalion had been selected to send a column into the Naga Hills in order to get behind the Japs, to find out which roads and tracks they were using in their retreat, and to signal this information so that our air forces might have more accurate strikes at them. The Jap 31 Div. was then in full retreat from Kohima to Ukhrul, the latter being at that time the rear H.Q. of their 15 Div., which was holding the Litan approaches. John Sanders' Company was going out with George Lorimer as second in command, and myself as M.O. We were to go out on a man-pack basis with two days' rations, and after that were to live off the Naga villages except for tea and cigarettes. We should be out only two or three weeks, but, as often happens in the Army, it was nearly six before we returned. As the monsoon was then at its height I am afraid that my response cannot have sounded too enthusiastic, but how wrong we all were as, at that time, we knew nothing of our Naga Intelligence Officer, Khating, a B.A. (Economics) Calcutta, and the Headmaster of Ukhrul School.

I joined John's Company, now to be known as Sancol, in 20 Div. Box. Sancol consisted of a Company of about 120 men, a section of Assam Rifles, and a few Nagas under Khating who would join us in the hills; it would operate directly under Div. H.Q. At that time we were billeted in some Manipuri huts

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in a sea of mud: to illustrate conditions, the subsoil water was so high that the deep trench latrines had to be built up three or four feet. It was not easy to get equipped up to the scale we wanted, as supplies at that time were extremely short and, as everything was secret, it was not easy to take things away from other people who themselves had barely more than they stood up in. Our short stay at rear Battn. H.Q. was made most pleasant by Joe Aubrey and Jack Duthie, our Q. and M.T.O., both large and cheerful individuals, who were not above purloining in order to equip us properly. From our bashas[1] we could see the great Maphite range over which we must go, about ten miles to the east, nearly always covered by rain clouds; it did not appear to be a very easy climb, and it was interesting to speculate what lay beyond. Intelligence was extremely sketchy; along the ranges there were supposed to be Jap foraging parties, and possibly a Brigade of Jifcs[2]; Medical intelligence was even sketchier. So as to be on the safe side, we armed ourselves with as much mepacrine, sulphaguanidine and anticholera vaccine as we could carry. At last we were ready. The day before we set out, the Commanding Officer came down to see us on our way, he had brought a large number of cigarettes from the other officers, which was a most welcome gesture and much appreciated, as they were precious ones from home. It had been impossible to build up any store to take out, as cigarettes then were impossible to obtain from the canteen, and were only an issue of the "V" variety (some 30/40 a week), which always looked as if a mule had rolled on them by the time they reached us! That evening the G.O.C., General Gracey, who had formerly been in the 1st Gurkhas, came down to wish us the best of luck. As John was marshalling the Company, George and I were posted as lookouts on the road; we had expected a Jeep with escort, but a little man with a walking-stick appeared coming down the road by himself. He apologized for being early, and then began to address the Company. He spoke to each of the Gurkha Officers and N.C.O.s in turn, and then addressed the men in Gurkhali, punctuating his remarks with a series of "Ehs" as only a British Officer in the Gurkha Brigade can. The men were very braced.

Next morning we set off, feeling rather like Christmas trees. Apart from full scales of equipment I was carrying a medical haversack, another one full of papers for dealing with captured prisoners, and the third copy of our codex. We had with us two days' "K" rations and, in reserve, tea, sugar, milk and rock salt for the whole time, which, with the reserve ammunition, was carried on mules; these we could take as far as the Toubul river, where the supplies would have to be carried on by Nagas. We could expect no supply drops as we would be operating too close to the Japs, and the essence of the column was to send back accurate information of their movements as quickly as possible. Our way lay first along the tarmac road for about four miles, after which we struck off to the right over paddy. It was raining steadily the whole time, and with the great mass of hills in front of us, and the thought of living in the jungle for three weeks, we were not at the peak of our form. We had capes

[1] Bamboo huts.

[2] Japanese inspired fifth column, later known as Indian National Army (I.N.A.).

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to keep off the rain, but in the humid atmosphere we perspired a great deal, so that it was preferable not to wear them but rather to become soaked through, then, at least, one felt clean. About midday we stopped for a meal, and then started to climb the first range—we were soon at the top, and from it we could see the Toubal river below. We began to descend, and, on top of the last ridge overlooking the village of Tumoukhong, came across a Company of the 3rd Madras Regiment commanded by an Indian Major; they were the last outpost on this flank, but maintained a platoon across the river. They gave us all the "gen" and a most welcome cup of tea. It had stopped raining by this time, but in the middle of tea John looked up, and, seeing the clouds gathering again, decided to push on and cross the river before we got wet. Looking back it always struck me as an odd remark, as the water in the river was above our waists. The river was about a hundred yards wide, and without mishap we crossed with all our stores and bivouacked in the village. It was the last Manipuri village before the hills; it was half-deserted and the few inhabitants were quite indifferent to our approach. The Manipuris dress rather like the Indians, but in appearance have rounder features. We spent the night in the huts and were very badly bitten by fleas. In both Manipuri and Naga huts fleas were an awful problem—how difficult they were to get rid of! The only solution we found was to cross another river and drown them!

Next morning at half-past five we began the climb of the Maphite range, and what a climb it was! The narrow footpath appeared to go straight up, and in the first two miles we climbed two thousand feet; as it was very slippery from the rain it was both tiring and sweaty. In some parts the gradient was so steep that you doubled up so as to keep the centre of gravity of your heavy load forward, otherwise you felt that you would roll backwards down the hill. We reached Nungdam, the first Naga village, about eight o'clock feeling almost too exhausted to cook, and there we met Khating and realized what a treasure we had. Everything had been laid on; water was boiling for the men's tea, and he had an enormous curry ready for us. He appeared as fresh as paint and was obviously wondering what all the panting was about. The Nagas' leg, from constant climbing, has become mechanically adapted to gradients—Khating told us that it used to tire him to walk on the flat! The meal was excellent, and his cook first class. I believe he had been a servant at one time to a District Officer.

Here it was decided to send off a pigeon to let 20 Div. know where we were. Pigeons, I suppose, are useful, but they certainly have their limitations. As they have to be released within six days of setting out, owing to their losing their homing instinct after that time, there did not really seem much point in having them, especially as in the early stages W/T communication was no problem, unless when you were the wrong side of a hill, by which time you were several days away from your base. After much trouble a message was affixed to the leg of one of the birds; it circled round twice, and then tore the message off on the top of a Naga hut. Someone then had to climb the hut to retrieve the message, but the bird wouldn't be coaxed back and another one had to be sent. I saw my first patient here, an old woman with a most appal-

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ling infected arm (probably from scabies which was very common in these parts, particularly among women and children); we did our best to clean it up and left some dressings for her. It must have done some good, as some weeks later a runner came in and asked for more dressings for her. We soon found that medical supplies were one of the two things we had slipped up on administratively. We had only calculated them on our own needs but found soon that we ran extremely short, as in no time we were having quite a considerable sick parade of locals. This was, however, useful from the point of view of obtaining information, fresh eggs and chickens. The other mistake was rock salt—this, again, had been calculated on the ration scale level but, owing to the enormous climbs which had to be made, we were losing a great deal of sweat and so using far more salt than we ever estimated. In addition, it was the only currency that interested the Nagas. We started again at eleven-thirty and soon had to make our first detour—this was to avoid the neighbouring Kuki village. The Kukis, although not hostile, were known to be assisting the Japs. They were reported to have provided the guides for the Japs when the latter had made their really amazing move over the Naga Hills to surround Imphal and invest Kohima. This move involved (after crossing the Chindwin on rafts) bringing two Divisions on foot, with their artillery carried by elephants, some hundred miles across the grain of the Naga Hills whose peaks were about ten thousand feet high, and whose average height was some five to six thousand feet—all this being accomplished without air superiority. The relationship between the Nagas and the Kukis was interesting; the former were the workers and the latter the idlers. Kukis, who grew their hair long, were attractive to look at, wore little clothing, gaily coloured head-dresses and usually earrings and were, in fact, similar to the Romany type. The Nagas, although having little to do with them, did not appear to have any feelings of enmity against them, nor did we hear of any fighting between them. The detour was a nuisance, as, although it only lengthened the journey by about half a mile, it meant climbing sideways up a hill through the jungle and then down the other side on to the track again. After a climb of another two thousand feet we were on the back of the Maphite range; the next two miles was a comparatively easy coast down to Tangkhul Hundung Khunou, our first H.Q.

Here we were well housed in the largest hut, the family having been made to double up elsewhere. Naga huts are built of bamboo, the floor a few feet above the ground, and the roof covered by thatch. They were pitch dark inside and the beds consisted of wooden planks; being dark inside is an advantage because, when you eat, you are not troubled by flies. Arriving in Tangkhul was like arriving at an hotel, not to a rendezvous on an operational patrol with the Japs in the neighbouring village. We were asked if we would have a meal or a bath first—we goggled, but it was true, for Khating's servant had boiling water waiting in the ubiquitous kerosene tin. Clean and refreshed we then sat down to an enormous curry. Next day, while John was busy arranging his patrols, and George organizing a platoon which he and Khating would take as near to the Humine-Ukhrul jeep track as possible, I

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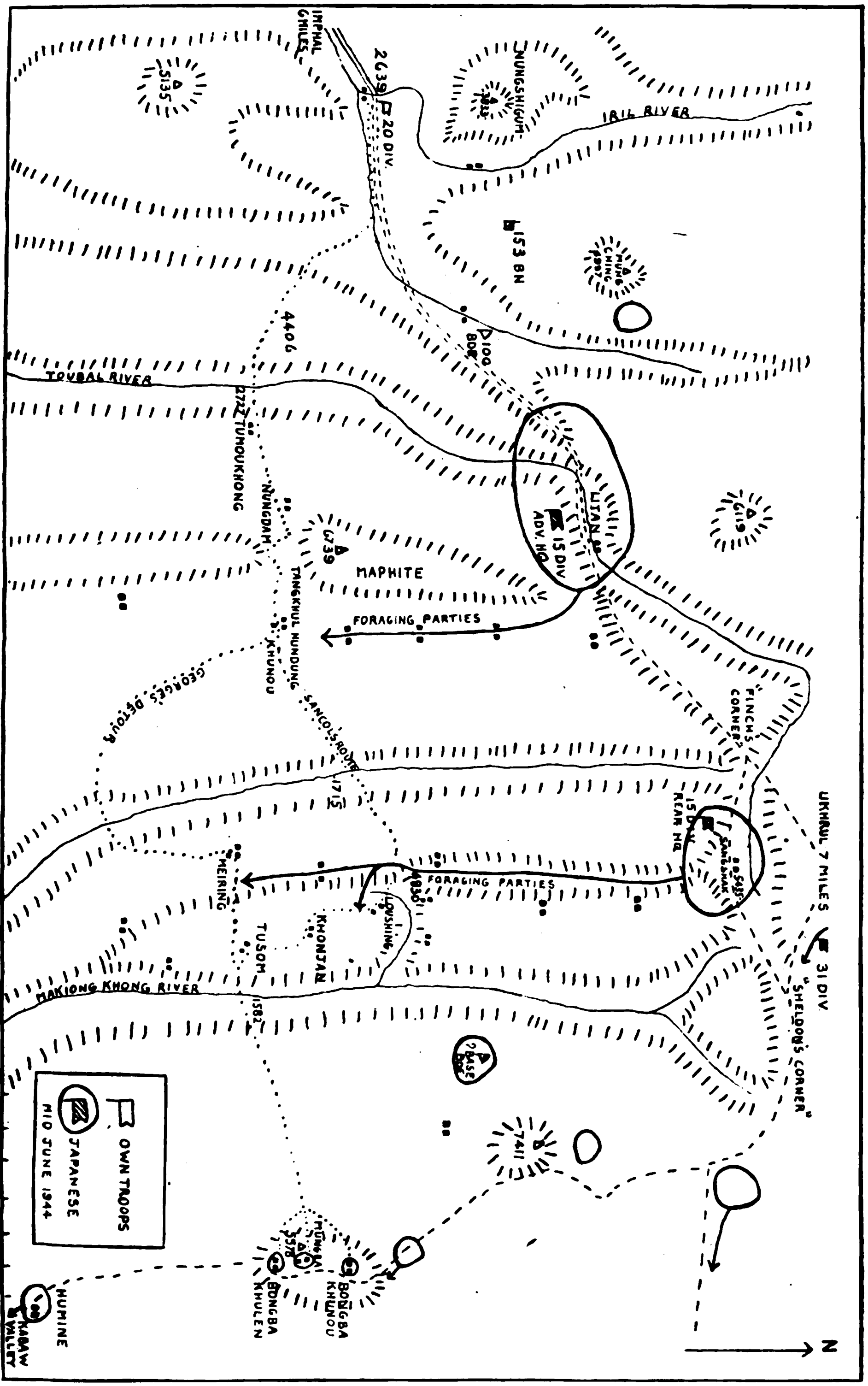
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SANCOL'S ROUTE
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was doing a sick parade of locals. Half-way through, noticing Khating looking particularly smart with pressed clothes and polished boots, I asked him what he was doing; apparently he was going to church. By now I had ceased to wonder at anything, so I said I would go with him. We went to a corner of the village where there stood a clean whitewashed adobe type of building. Inside was a table at one end, and pews down each side which allowed for the complete segregation of the sexes, with the smaller children to the front. A Lay preacher took the service, which I couldn't follow as it was in Naga although the hymns were easy as they were all to tunes we knew. Various church officials addressed the congregation at the end, in a similar way as at a Friends' Meeting. Finally, the last hymn was sung and a collection taken—it was quite surprising to see the number of five and ten rupee notes. It was all quite simple and very moving that such a primitive people should be holding a service in a half-deserted village surrounded by Japs. These Nagas had been converted by American Baptists, although the main body are still animists. The Naga village is divided into two, sometimes three, sections, one of which is Christian: this is nearly always the cleanest section but there Zu[1] was not obtainable. To quench one's thirst with Zu one had to go to other parts of the village. Nagas are of our build and height, but Mongolian in cast of feature. They wear little clothing, but all have a sort of diaper or loincloth, whilst the women tuck a sheet as well round their shoulders. When doing hard work, such as rice husking, the sheet is usually lowered to around their waists. The men all carry a dah, or native knife, fastened to a half-split piece of bamboo, which is tied round the waists and bangs about on their buttocks. The hair styles were interesting. Children wear a "bob" with a fringe. On marriage the men's heads are shaved on either side, leaving merely a central tuft. Women, however, grow it long, greased and combed down the middle. Christians, on the other hand, wear their hair cut in the same manner as ourselves. Some were astonishingly smart—I remember the first Naga we saw in that village, and John remarking how much he resembled somebody you might expect to meet in an American Bar.

From Tangkhul Hundung we had a magnificent view of the country. To the north you could pick out the jeep track in front of the Sangshak plateau, about twelve miles away. There the Parachute Brigade had fought their rear-guard action during the first impetus of the Jap advance. To the east stretched range after range of green-clad hills, whilst to the south-east, through a gap in the hills across the end of the notorious Kabaw Valley, you could just see a bend in the Chindwin River. The river was easier to pick out in the early morning when there was nearly always a mist above it. From the village we were in W/T communication with 100 Brigade, who were our link with Div. For the next ten days life became routine—John used to sort out our patrol reports (and some most conflicting information from the Nagas), while I would deal with the local sick and give him a hand with decoding. We were using Codex, but groups of letters which had passed through two links of Gurkha

[1] Rice wine.

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signallers tended to be corrupted, so that it was rather like working out a crossword anagram. The village was in no sense a firm base as we had to be at all times ready to move at a moment's notice. Twice we had alarms—the second being rather amusing. A Naga approached gesticulating wildly. There were only John and myself and a few men about, so we hastily shovelled all the maps and codes into our haversacks and prepared to move off. Luckily a Naga-speaking Assam Rifleman appeared, and it eventually turned out that one of the pigeons which we had despatched had returned. At night we used to leave the village and sleep down in the jungle, and I must say we were lucky those few days as the rain held off. Daily the odd Jifc used to be picked up by our patrols, or fellows would come in who had been captured and had managed to escape. Now came into use much of the paper we had brought. Each Jifc had to be examined, and a record in duplicate made of his clothing and possessions, and as to whether he had shown fight or had given himself up. This was, apparently, necessary to assist in his later classification as Black, White or Grey, but it was a great nuisance as it was so difficult keeping any paper dry during the monsoon. When finally a party of about thirty came in, whom George had captured after a fight near Meiring, we gave up and sent them all back with a single covering note, for which, in due course, we received the most imperial rocket from Div. It was difficult to see what else we could have done. The only dry containers I had were an anti-gas wallet, and a cylindrical one which contained the codes. This one was supposed to hurl against a tree if one thought one was likely to be captured—the theory being that all the papers would then be destroyed. How complicated is war! Amongst those captured was a well set up V.C.O., who had been captured in Malaya and then had gone over to the Japs, by whom he had been commissioned. Here was a man who was being sent back to Court-Martial and an almost certain death sentence—this at a time when Subhas Chandra Bose was regarded by some as the coming liberator of India.

Meanwhile, the Manipur road had been opened and since that time the situation had improved to such an extent that they were able to send a battalion up. We had hoped to see the rest of ours but, unfortunately, they were chasing Japs around the Mung Ching. However, it was our sister Indian Battalion (now commanded by Reggie Steward), so that we were able to have a pleasant gossip. I handed over my cases to their M.O., including one rather odd breast abscess. I had operated on the woman using pentothal, with my batman as assistant, an Assam Rifleman as interpreter, and the woman's husband to see fair play. At that time it was the practice still to count down to tell when the patient became unconscious. After much difficulty, I had managed to get the woman to count; after a few seconds she stopped, and on rather laboured enquiry (as it went from me to my batman, who interpreted my Gurkhali to the Assam Rifleman, who spoke in Naga to the husband), it turned out that she could only count up to ten as that was the number of fingers she had got! While feverishly trying to think of something original for her to say she appeared to go right out, so I hastily did the operation amidst furious arguments. I could have sworn that I left a swab in, but the M.O. to whom I

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handed over said that the wound had healed first time—so I have always thought what a marvellous thing acquired immunity is.

The following morning, John and I, with two sections and our Nagas, pushed off to join George. We were rather a nondescript party—ahead were two unarmed Nagas who acted as our eyes and ears, then our advance guard, and then the Naga cooks with odd bundles which they carried in baskets on their backs, together with a most entertaining individual complete with umbrella. The whole expedition was obviously quite an excursion for him, he was hopping about and emphasizing any point he wished to make by jabbing with his umbrella, but he was obviously a pain in the neck to John's Sandhurst trained eye and, shortly afterwards—to my inward regret—he was banished to the tail of the column. This time, instead of going round, we were going to cut across the track along which the Japs held village strong points. When we reached that track we hurried across it so as not to be seen by any locals. The next part of the journey to Loushing was extremely hard work. As the Japs were in all the villages, we went straight across country, and I assure you there is hardly anything more tiring than walking up and down along thickly clad spurs of hills which are trackless. About four o'clock we decided to make tea, and halted in a very thickly wooded nullah. Just at that moment some Hurribombers started to bomb a village up on a hill. Probably it was the wrong one so we asked them to bomb elsewhere, still it was interesting to watch until one of them peeled off and started to circle around us; he must have spotted our smoke. The fires were immediately put out, which upset the Gurkhas as they couldn't understand why we should worry about our own aircraft (refinements such as being on the wrong side of the bomb line rather went above their heads). Luckily he pushed off and John and I breathed again. Shortly after this we moved off, but soon bedded down on the crest of a spur for the night. It was fine again and we were filled with a splendid feeling of exhilaration: to have gone any lower would have meant being bitten all night by mosquitoes. Next day we dropped down into the nullah, and met the whole village of Loushing. They had left their own village and were all living huddled down on the banks of this stream to be as far away from the Japs as possible. Here we gathered useful news—there was, apparently, a medical relay station in the village of about a dozen Japs. The villagers lent us a guide and we pushed on. We halted just short of the village, and John went ahead with the Bren-gunners. Unfortunately, one of them tripped before the village was properly surrounded and let his gun off. The Japs had only a yard to go for the jungle, and made it, but they had left everything behind—weapons, boots, shoes and clothing. It was quite amusing to think of them wandering around in the jungle in their short pants. We removed any papers of value, and then piled all their kit into one basha and set fire to it—unfortunately we heard later that we had burnt the whole village down. We were very sorry about this as the Naga huts are beautifully made and carved. One thing we learned from this encounter was how careless, behind their forward troops, the Japs are—these men had posted no lookout. Their sanitation was poor, large stools being found close around the village and even in some of the bashas.

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We obtained some most useful mepacrine and quinine, the former had been captured from us, the latter from the Dutch. Shortly after leaving the village we nearly ran into a Japanese patrol that had come to investigate the fire; luckily they were nearly as surprised as we were and we had time to push off into the jungle without hindrance. We arrived at Khonjan about four in the afternoon and were most glad to welcome George and Khating when they arrived a couple of hours later. We were a little surprised at the timing but George said that he had received through Khating almost hourly reports from the Nagas about our progress since we had left Tanghul Hundung. Khonjan was infested with rats and fleas, having been deserted for some time and its livestock ransacked by the Japs. The pig is a real scavenger who will eat almost anything—he is the primitive form of sanitation and lowers the possibility of vermin infestation: no wonder the Old Testament Jews forbade its flesh! We always took the view that pork was too good to miss, and hoped that adequate cooking would mitigate any consequence that might occur in about fifteen years. The odd family returned and there were some very obliging girls who insisted on doing all washing for us. We had only been there a few days when tragedy hit the village. Suddenly one night the most appalling wailing of women started—it was really deafening. We hadn't the slightest idea what had happened until Khating arrived and discovered that the Japanese had just killed some ten of the villagers. The awful thing was that we were partly responsible. These village men had led a Jap patrol to where they thought George was in ambush; unfortunately he had been forced into the jungle by a Jap company. When these Nagas got to the spot where they thought the ambush was, they had speeded on ahead: as nothing happened the Japs, smelling a rat, had killed them out of hand. This was, in point of fact, the first time we heard from Khating that the Japs had done anything in this way to the locals in that part of the world. The wailing went on all night and next day. We then had to move on as it was impossible to get any water drawn or any domestic details attended to.

The following day we pushed on to Tusom, which was deserted on our arrival. Soon a few villagers appeared from the jungle, and under the supervision of their headman, they rapidly had a few huts cleaned and made ready for our use. The headmen could always be distinguished as they wore a red blanket, which was the insignia of their authority from the District Commissioner. All other Nagas carried a light blanket or sheet which they used either as a protection from the wind, or in which to carry loads; this they did by twisting the load in the sheet and placing one end over one shoulder and the other under the other shoulder and knotting the loose ends in front—that is how women carried their babies, and it used to be most amusing to watch the child's head bobbing up and down as the mother husked rice. Here, as news got around that we had arrived, villagers poured in from all directions, and we had something like four or five villages billeted on us. It was comforting to know that, in spite of all the vicissitudes for which they had been so little prepared, the Nagas still put their faith in us. One day one of our aircraft flew low overhead—"Sarkari" was all that one of the Nagas said, and it was

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obvious which government he meant. It was an unconscious tribute to the great achievements of the relatively few British administrators of the Hill Tracts.

The nights were wonderful. Being pleasantly warm, we used to sit outside and watch the short twilight and, in its dying light, the nightly dance of the restless fireflies. We would then go in and have our evening curry round the open fire, which burnt at one end of the hut on stone flags—each morning the fire was re-kindled from the ashes of the previous night. Everything was cooked on a stone tripod and above it was suspended a basket where the next logs for the fire were dried, the smoke making its way out through the rafters. Having dined we used to sit gossiping on our plank beds listening to the harmonious voices of the girls singing outside. Every evening they would collect together and sing hymns or ballads (or rather Naga songs with familiar hymn or ballad tunes), and we were always sorry when they stopped. Shortly afterwards George was presented with a handkerchief embroidered by one of the girls. I felt very jealous. At this time we had run out of cigarettes, so we used to make them out of "Bromo" and local tobacco leaf dried. To one cut off from cigarettes the first few puffs were extremely pleasant but the final result was not so pleasing. John used to smoke it in his pipe; he always swore that it smelt like a manure heap but in order to obviate this disadvantage recommended holding your nose while inhaling.

Div. were now beginning to get impatient about a large scale raid on the road. John was livid as he was constantly asked to send patrols here, there and everywhere. To concentrate the Company would take two or three days, as five miles in that country was a good day's going, and Div. appeared to think that we were operating in flat country. Eventually the Company was collected and we moved off with one day's rations—John had gone ahead to recce. The site chosen for the raid was Mungta and the two Bongbas, as they were known to be large staging posts for Japs and, in addition, we had guides from those villages. Rain was pouring down and, after the river had been crossed, to avoid the track all climbing was done through jungle. About four o'clock we halted about two miles short of our objective for the evening meal. Khating, as usual, had produced a miracle—he had unearthed a large drum of "V" Force rations from somewhere, which contained many "delicacies," including a very welcome bottle of "Black and White." One blessed the whisky manufacturers as one watched the rain cascading down, with the Japs literally sitting above one's head. The Company then moved off split into three parties, one for each village. Only George's bumped a sentry, who luckily must have been fast asleep as he did not raise the alarm. The parties were led by the guides straight on to the bashas where the unsuspecting Japs were sleeping. It was a massacre. At first light when the first Japs came out they were mown down, while magazine after magazine of Tommy-gun was emptied into the bashas. The parties then withdrew to the rendezvous at the river. There, instead of finding that our troubles were really over, it was discovered that they had hardly begun—this was the only time that Khating slipped up on the arrangements. The men arrived ravenously hungry after a most gruelling night's march, to find

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no food. To complicate matters, the river had risen several feet and it was impossible to ford; for that matter it was impossible to cross by raft as the water was very fast moving and dotted with numerous rocks. At first sight it was a little awkward—caught the wrong side of the stream with no food. For want of any better idea, a start was made on felling an enormous tree with Kukris but, before it was possible to test the theory that the tree would have bridged the stream, one of the Nagas hurried up to say that he had discovered a bridge. This meant a rather difficult journey downstream, up and down a few spurs several hundred feet high, over ground so slippery that you were mainly on your hands and knees. We turned a corner, and there was the bridge —one of those three string affairs, one for your feet and one for each of your hands. We were frightened to look at it in case it collapsed, but each in turn gingerly stepped on and got across safely. Then began an almost perpendicular ascent, where it was simply a question of getting a hold with your hands or feet of whatever you could find, such as roots, rocks, or bamboo shoots. After climbing a thousand feet the men were dead beat: luckily the ground flattened a little and we were able to make better progress. Halts were becoming more frequent, and at the end of each one some of the men had to be shaken as they had fallen asleep where they lay. It was pitch dark now, and we kept arriving at the top of false crests—it was heart-breaking country for these. Then we smelt a dead Jap; I don't think we had ever felt so happy at smelling one before. He fixed our position, as he lay near a path intersection about a quarter of a mile below the village. We hurried up the next slope and saw the welcoming fires in the huts. The villagers were very glad to see us back for when we left a lot of them had taken to the jungle again.

The Japs were now in full retreat and were to be found on all the neighbouring paths. We even captured one and wondered what the reaction amongst the men would be. They seemed very fond of him and fed him well, but kept him on a piece of rope when he went out. By now the rest of our battalion was working south to come up with us, but had been held up by numerous parties of Japs streaming south. Reading the W/T signals was like listening to the cricket scores, to hear that Harry's company had got fifty Japs, and Bones' seventy, and so on. In preparation for the arrival of the battalion we had a supply drop, and what a nightmare it was. For several days you could hear the R.A.F. trying to find a hole in the clouds; then one day they succeeded. How they ever spotted Tusom was difficult to say, as the many villages, none of which had any particular distinguishing marks, were dotted along the innumerable spurs which were nearly always covered in clouds. Before dropping commenced there were two problems to be solved—one was ours and the other the R.A.F.'s. Theirs was that the D.Z.[1], i.e. the village, measured about a quarter of a mile by fifty yards. As the village was sited on the crest of a knife-edged spur, anything that missed this edge fell into the surrounding jungle many feet below and was usually never seen again. To ensure dropping the supplies on the D.Z. meant flying low—this was made more difficult by a large hillock at the top end of the village which was covered in cloud.

[1] Dropping-zone.

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Our problem was the five hundred odd women and children who thought the dropping had been put on for their entertainment. We managed to chase most of them up to the top end of the village, but a number insisted on sitting under some of the huts in the middle. As it chanced, a box of grenades tore itself from its parachute and hit one of those with a tremendous thud—the Nagas left like scalded cats. After that the D.Z. was clear. The dropping was excellent—so different from the early days—three aircraft made about ten runs each and we lost only two parachutes. How quickly even the Nagas became accustomed to the new method of supply. Half-way through the dropping, Khating's servant came up beaming, to say that he had a pot of water boiling as he could see that tea was arriving.

It was fun those last few days, calling for an airstrike and then watching the odd flight of Hurribombers attacking the appointed village. From where we were it was as if we were watching from a box at Wembley. Our only worry was in case they might mistake ours, so we used to lay out ground recognition signals of Naga blankets, and stroll nonchalantly around the village. Although these strikes looked impressive on villages, it was probable that little damage was done, as almost certainly the Japs were taking cover in the surrounding jungle. Now it was obvious the tide was turning. One night two Kuki chiefs came in with chickens offering information. George examined them, but refused the chickens. I thought it rather foolish, but, as he pointed out, from the high policy level they should not be allowed to go away under the impression that the two chickens were sufficient atonement for their past misdemeanours. Now we were beginning to collect a great deal of information about the I.N.A. It was odd to note how in that Army, controlled by the Japanese, it should be found necessary to use English as the official language. They were given all sorts of injections including one against dysentery. Their pay books were not dated in our style, or the Japanese, but the year 03, time being taken from the fall of Singapore. It must have been all most confusing for the Paymaster.

At last the signal arrived—next objective Secunderabad Club! We were sorry to leave our friends the Nagas, but to say that we were not glad to go would be untrue. We were going back for further parachute training, which was our normal rôle. We had been sent down to Assam for two months and had been there nearly five, most of us having lost all our kit within the first fortnight, and finally we had been sent on a three-week patrol which had lasted nearly six. Returning was no particular problem, except for our invalids. We had one case of pneumonia, while George and a Gurkha had thoracic herpes. The pneumonia case had to be carried: we made a stretcher out of air supply basket panels with very long runners, so that the two porters at each end could walk one ahead of the other, and thus manage on the very narrow path. Owing to the steep undulations of the track it was necessary to strap the patient down. Nagas were used as porters, and worked eight at a time from village to village—it was a wonderful sight to watch them manipulating the stretcher across the swollen streams. On our return journey we spent the night at Loushing, which was still practically deserted, and felt quite sad that it was to

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be our last night with the Nagas. To-morrow we would be back with Battn. H.Q., and they with their own people. Next day, after a quick march, we had tea by the stream below Tangkhul Hundung, and felt very loath to go on. After weeks away from people, one resented one's privacy being broken into. John went on ahead to report, and George and I followed at the rear. Poor old George could hardly move, he had been suffering agony for the last two days from his herpes but hadn't said a word—now he was about finished. At last we reached the top, and there was Dick Willis and his H.Q. waiting to meet us. As usual they were grand—hot tea, whisky, cigarettes, and welcome mail from home, particularly news about a weapon (the V.1), which was a new one on us. One's jaws ached from talking. Before turning in I went to see my medical havildar, Ranbahadur. After the usual questions I asked him where the M.O. was—Ranbahadur beamed and said he had been doing the work for the last ten days since the battalion left the plains.

We had hoped for a day's break, but it was not to be, as we were on the move by six in the morning. Having seen George on to a riding mule, and discovered that Ranbahadur had everything under control, I wandered on ahead down the hill by myself. I had done no patrolling, nor had I been sick, but I certainly felt tired—it was probably the reaction of the long march and the relaxation from being constantly on the qui vive. Thank goodness it was mostly downhill. Sweating troops, cursing at their mules, were coming up in the opposite direction—one felt very tempted to tell them the first four thousand feet were the worst! We had a short halt at Nungdam, where we had our last most refreshing drink of Zu, before we carried on down to Tumonkhong. There we had a splash in the river, and were able to wash out all our clothes. It was the first time that we had been able to frolic in a stream for nearly two months—normally the main idea was to be in the water the shortest possible time, in order to regain cover on the farther bank. We bivouacked overnight in the hills above where the company of the Madras regiment had been: next day we had only a few miles to go to the road. Reaching this we realized how Rip Van Winkle must have felt after leaving the hills. Even though we had been away only six weeks the countryside looked so changed—the paddy had grown right up, barbed wire had either been removed, or had become overgrown by vegetation, and even the troops were different—the 33rd Corps, with their curious wireless flash, being now in evidence. Two days were spent in "Catfish," the box in Imphal in which we had reorganized after Sangshak, and then we were away by air to Calcutta. This was a journey of three hours' flying time as compared with the five days of railway, river steamer, M.T., and foot.

It is impossible to estimate factually Sancol's exact contribution to the disruption of the Jap retreat, but materially, in ambushes, against one killed and two wounded of our own, over a hundred Jap bodies were counted; but little of this could have been achieved without the assistance of the Nagas. They provided much information, and maintained us entirely. These primitive peoples, who were head-hunters only a few decades ago, had never lost faith in the British, even during the darkest days at Kohima. During present political changes in both India and Burma, the thoughts of many Britishers must turn

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to the staunch hill peoples, the Nagas amongst them, and wish them well in their difficult times ahead; and, as we gaze on the war memorial at Kohima, we think of many others:—

> "When you go home
> Tell them of us, and say
> For your tomorrow
> We gave our today."

I wish to thank Colonel G. T. Gimlette, A.D.M.S., Home Counties District, for permission to forward this paper.

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Notices.

PRIZE COMPETITIONS, 1948.

The Council of the Royal Sanitary Institute have announced particulars of the prize essay competitions for 1948. Two prizes are offered: The John Edward Worth Prize of £40 for an essay on "Practical Improvements of Appliances or Inventions in or about Dwelling-Houses," and the John S. Owens Prize of £15 for an essay on "Atmospheric Pollution."

Entries must be submitted by December 31, 1948. Intending competitors should apply to the Secretary of the Royal Sanitary Institute, 90, Buckingham Palace Road, London, S.W.1, for a copy of the general conditions.

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Review.

Chronic Structural Low Backache due to Low Back Structural Derangement. By R. A. Roberts, B.Sc., M.B., Ch.B., D.M.R.E. H. K. Lewis & Co., Price 45s.

Dr. Roberts's book is obviously based on much experience, much study of the work of other writers, and much critical analysis.

In the first half he gives the case-histories of 51 cases of chronic structural low backache with the X-ray photographs. These photographs are difficult to understand even when the lesions are shown on accompanying tracings, but they certainly merit close careful study. He demonstrates the necessity for taking X-rays in the oblique position to show an abnormality of the pars interarticularis of a vertebra, a hitherto rather neglected lesion, the great importance of which he describes fully.

In the second part of the book he draws a series of convincing conclusions from the facts presented, and shows how to investigate and treat this type of case. He suggests that it may be callous folly to diagnose hysteria, anxiety state, etc., where a patient complains of low back pain and no physical signs can be elicited. An attempt is made to view different pathological conditions of the spine in their true perspective as when he states (p. 64): "It is more likely that the herniated disc, the sacroiliac strain with its occasional evidence of

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arthritis and the overstrained muscles with all that this means, are each end-results of low back structural derangement."

The chapter on neurovascular and visceral symptoms should be read with special care, as it may prevent an unnecessary abdominal operation. The osteopaths have long averred that lesions of the spine may have symptoms similar to appendicitis, gastritis, renal colic, etc., and Goldwaite is quoted (p. 67), as saying: "It is beginning to be realized that many of the painful symptoms in the region of the appendix, lower abdomen and gall bladder may be due to this cause (lesions of the dorsi-lumbar spine) rather than to any pathology in the viscera themselves." The evidence supporting this is convincing, and he makes a strong plea for the radical reassessment of our differential diagnosis to include pain of spinal origin when considering abdominal symptoms.

Radiologists, and clinicians (be they physicians, surgeons or psychiatrists) who have to handle cases complaining of low back pain, will find in Dr. Roberts's book an illuminating and authoritative presentation of modern ideas on a complex difficult subject. The book was written under the active service conditions of a temporary base hospital and will be found specially helpful by medical officers of the Services.

J. F. S.

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Original Communications.

HEALTH EDUCATION IN THE ARMY.

BY

Major H. J. A. RICHARDS,
Royal Army Medical Corps.

[*Received February* 6, 1948].

INTRODUCTION

DURING the past few years it has become increasingly obvious that with an awakened sense of responsibility for individual, family and community health many present public health problems will disappear. Indeed, it is now apparent that all real progress in improving the health of the community, and in the attainment of true positive health, will depend upon the active co-operation of a public opinion educated in health matters to a level far above that which exists at the present time. This is no new phenomenon, the awareness of the importance of health education has gradually been growing over the past hundred years but recent experience, particularly during the Second World War, has emphasized the paramount importance of ensuring that all plans for social advancement are based upon the intelligent co-operation of an enlightened public.

This realization of the necessity for adequate health education is now firmly established, and everywhere spasmodic effort is giving way to a continuous long-term plan. In this plan the Army will play a major rôle, for with the advent of compulsory national service most young men will serve one year in the fighting Services and of these about one-half will serve in the Army. These young men will be in their late teens and will soon become responsible citizens and parents—they are therefore the very people of whom successful health education will produce the best results. It has been shown during the war that the large numbers of men living together acquired new ideas on hygiene, and the habits learned in the Services remain active after their return to civil life [1]. It is now one of the tasks of the Army to ensure that what was done for the wartime soldier is continued and improved for

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the national service soldier in the peacetime Army, in order that he too will learn during his service some new ideas on hygiene which he can carry back to civil life.

Historical

The Army has always had cause to promote health and maintain the efficiency of its soldiers. For thousands of years men have realized that the most common cause of defeats or disasters in war has been sickness and disease—all the great commanders of history have been preoccupied with the problem of keeping their armies intact, their troops healthy and fit for battle. It has always been a pleasing convention to regard Moses as the first military commander to publish a Manual of Hygiene—with the Book of Deuteronomy and the Levitican Precepts; but all the great military leaders have paid the utmost attention, within their limited knowledge, to the health and welfare of their troops. Caesar, Cromwell, Marlborough and Wellington were particularly outstanding in this respect [2]. However, these were men with a comprehension far above the ordinary; the great mass of any Army, in common with their civilian counterparts of the time, were ignorant of the simple rules of health.

Knowledge about the promotion of health and the prevention of disease was slowly gathered, and as military hygienists the names of Pringle, Munro, Robert Jackson and Desgenettes are outstanding among the pioneers. By the beginning of the nineteenth century this knowledge was of a fair standard, but it was confined to doctors and a few laymen—the wide dissemination of such knowledge was not considered to be either possible or necessary. In 1835 Sir Ranald Martin reporting to the Government of India could write:—

"Where the hygiene of an Army is judiciously regulated it may be kept in health and vigour; but allow an ignorant general to encamp on a marsh, let filth stagnate, fatigue excessively the men, crowd them in low damp rooms and, despite of drugs, they will fall as unripe and blasted fruit, not by the sword but by the fever" [3]. It was realized, slowly, that only through a knowledge of the methods of prevention of disease, and their inculcation into all ranks of the Army, would real progress be made. One of the first to realize this was Florence Nightingale; she took up the matter with her usual energy and in 1854 she wrote:—

"I have never been able to join in the popular cry about the recklessness, sensuality, and helplessness of the soldier. . . . I have never seen so teachable and helpful a class as the Army generally. Give them schools and teachers and they will come to them. . . . I am struck with the soldier's superiority as a moral and even [*sic*] as an intellectual being" [4].

It was due to the influence of Florence Nightingale that Sidney Herbert appointed a Commission for the consideration of Military Hygiene in an unrestricted sense. As a result an Advisory Board in Military Hygiene was constituted and an Army Medical School established at Chatham (1860) and later transferred to Netley (1863). The results were immediate and spectacular. Edmund Parkes, Professor of Hygiene at the Army Medical School from

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1860–1876, made a study of every aspect of military environmental hygiene and campaigned for the dissemination of this knowledge to all ranks of the Army—but particularly did he stress the education in health matters of all who had control ever the feeding, clothing or housing of the soldier. So successful was Parkes that when he died it was said, by Von Moltke, that:—

"Every regiment in Europe ought to parade on the day of his funeral and lower their standards in honour of one of the greatest friends a soldier ever had" [5].

By the time of the South African War 1899–1902 the work of Parkes and others was beginning to take effect, but only as regards those who were at the highest levels in the administrative branches—the main mass of the Army had not been reached. In fact this war taught a salutary, though bitter, lesson; driving home how poor was sanitary organization in the field under conditions of active service. Apart from medical personnel neither officers nor men had knowledge of preventive measures and there was little if any co-ordination between the medical and combatant branches of the Army [6]. Efforts were made to remedy the state of affairs revealed by this war and, by Army Order No. 3 of 1908, sanitation was made a compulsory subject of the examination for the promotion to the rank of Captain. The Army Medical School had by now been transformed into the Royal Army Medical College, Millbank, and the Professor of Hygiene of this College played a large part in setting the standards for this examination. There is no doubt that this step was productive of nothing but good, in that military sanitation was recognized as an essential factor in the professional education of soldiers, and enabled them to take an intelligent interest in a subject which they had ignored for too long [7]. Another factor greatly stressed at this time, was that whereas in civil life sanitation was managed by a special department responsible for public health, in military life these responsibilities must be undertaken by the Army itself, and a knowledge of the subject was therefore necessary [8]. This was a very sound attitude to take up, because, *inter alia*, it showed clearly the necessity for the health education of soldiers and thereby made the task easier—only too often in civil life the public have taken for granted the work of the health departments and have seen no necessity for themselves to acquire a minimal background of health knowledge.

Prior to the First World War, therefore, the Army had realized that both officers and men would comply with health regulations promptly as soon as they appreciated their value, and so it ensured that the officers received training in the methods of prevention of disease—in their turn the officers were charged with the duty of instructing the men under their command in these methods. This was the policy of health training which prevailed both during the First World War and afterwards. This policy was a good one, but it did not go far enough. However, it did help to produce a tremendous fall in the incidence of preventable disease, both amongst the wartime armies in the field and in the peacetime garrisons overseas, and in this it achieved its object, the prevention of sickness and disease amongst operational troops—an achievement now regarded as one of the triumphs of modern preventive medicine

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and sanitation. But meanwhile the enormous possibilities presented by the Army for a fuller education in health matters were being appreciated. It was realized that the thousands of men yearly discharged could carry with them to their homes more or less practical knowledge of the prevention of disease. as well as formed sanitary habits, which must be useful to them and to the people with whom they associated; so that military hygiene, as taught every soldier in the Army, could become one of the most valuable educational agencies under the control of the Government [9]. This realization was stimulated during the First World War by the work of the Royal Commission on Venereal Disease appointed in 1916 and of which Sir Allen Daly has stated that:—

"The concentration of large numbers of men under the care of medical officers among our fighting forces rendered mass education an easier task than it would have been under normal conditions" [10].

In the interval between the First and Second World Wars it became apparent that all future progress towards the reduction of disease and the achievement of true positive health could only be based upon the education of the public to a sense of personal responsibility in the matter of health. By 1927 it was authoritatively stated that the task before the Public Health Service was to instruct the public in the prevention of the causes of disease and in the simple laws of healthy living. in order to win a high standard of physique for the race [11]. This attitude towards health education had become firmly established by the outbreak of the Second World War in 1939.

Lessons of the Second World War, 1939-45

Early in this war it was found that among the young men called up for national service the proportion of illiterates and near illiterates was alarming. This proportion was particularly high in the Army because the Navy and the R.A.F. got the pick of the young men for the more highly technical duties. The extent and gravity of the neglected education of these adolescents (soldiers and auxiliaries) has been carefully and statistically assessed, and has recently been published. The problem that presented itself in 1939 and 1940, therefore, was that the Army had to take measures to improve the educational standard, and consequently the morale, of the fighting man and the serving woman [12]. The results achieved were amazingly good, and the whole of the Forces educational programme has been duly publicized as one of the major triumphs of the war. Included in this programme was a large measure of health education.

Briefly the health education programme during the war may conveniently be considered under two headings:—(*a*) Of a general or topical nature, and (*b*) of a more specialized nature, for a specific purpose.

General or Topical Health Education.—This type of information was disseminated by such agencies as the Army Bureau of Current Affairs, or ABCA as it was usually known, through their successful fortnightly publications. These covered such topics pertaining to health as "Social Insurance:" "The Population Problem:" "The Naples Typhus Epidemic," and included a

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masterly symposium on National Health contributed by the Chief Medical Officer to the Ministry of Health early in 1943, entitled "The Health of the Citizen" [13]. In addition numbers of short films and cartoons were produced for inclusion in the ordinary entertainment film programmes given by ENSA. Topical health lectures were given by visiting lecturers and by the regimental officers using the ABCA publications as a basis for such lectures or discussion groups. There was also a certain amount of general writing on health matters in Forces newspapers and magazines. All the education given by these means was of a very topical nature and dealt with matters which were the subject of current talk or Press comment.

Specialized Health Education.—This was of a much more definite and factual nature. It was confined to those matters which cause a high source of wastage in military life, some of which have little relation to civil life but others which have their exact counterpart amongst the civilian population. The type of health education considered under this heading was on such subjects as General Personal Hygiene; Prevention of Scabies; Care of the Feet; Field Sanitation; Tropical Hygiene; Prevention of Malaria; Prevention of Venereal Disease; Prevention of Typhus Fever—and very many other similar subjects. For this type of work great reliance was placed upon the use of short films and humorous cartoons followed by a lecture given by the Unit Medical Officer or by a special medical lecturer (such as the Divisional Hygiene Officer). Particular care was taken to ensure that the films on tropical hygiene were shown, on board the troopship, to every draft proceeding to the tropics. The other methods adopted were too numerous for a detailed recording, but they included such measures as local educational campaigns organized wherever any local hazard assumed major proportions, courses organized by Field Hygiene Sections or Anti-Malaria Units, "travelling circuses" with teams of lecturers and model teaching material—and many other methods.

Such measures of health education were continued throughout the war and their part in helping to maintain the health, morale and fitness of the armies has been acknowledged, but it is not perhaps fully realized how great was the necessity for constant repetition. It was found during this war that the knowledge of simple measures of sanitation and personal hygiene possessed by the British soldier was of a low order. This fact may be explained away by saying that as a nation we have become over-urbanized and that, as a result, the bulk of our population has had no necessity to concern itself with health problems or with matters of sanitation—because these things were dealt with promptly and expeditiously by the local health department. It may be said with truth that the British soldier's sanitary habits were as good as those of any other nation—and better than most—but the fact remains that it was only by the constant repetition of propaganda and health education measures that even a tolerable standard of hygiene was achieved. This was particularly noticeable in tropical theatres, where trained and experienced troops easily maintained themselves in health and efficiency, but where raw troops straight out from Europe were constantly falling victim to disease until they had been properly trained in health matters.

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The Present Position

With the end of the war in 1945 came many changes in the Army due to demobilization and re-organization for a peacetime rôle. One of the most far-reaching of these changes was the introduction of conscription or compulsory national service, which meant that every year many thousands of young men would pass through military training establishments. This was an opportunity for the Army to teach them, as part of their military training, some of the elements of good citizenship and healthy living. This opportunity was seized to the full and a planned scheme of further education and training was put into operation. The intellectual and moral aspects of this educational programme will not be discussed here, their achievements have been related elsewhere, but the part played by the Army Medical Services in the health education of the young man called up for national service will in time be recognized as one of the major advances towards better national health.

The health education of the present-day soldier may be considered under several different headings. There is, first of all, the training given to every soldier, and this includes both formal training and the continuous inculcation of good habits over a period of months. There is the further advanced training given to officer-cadets before they are considered fit to command men. There is also a specialized training given to certain officers and men by means of special courses at the Army School of Hygiene; and there is the training of substandard recruits at special centres. Finally there are the varieties of health education which are being tried out but have not yet been fully established—such as sex education, and other experimental schemes as noted below.

It may be profitable at this stage to consider in some detail the health training given in the Army at the present time.

Formal Health Training

For All Recruits.—In considering the more formal training given to the recruit in the earlier days of his service it should be stressed that all the health training of the soldier has a dual purpose. It is so designed as to, first of all, enable him to live the communal life of the Army, in this country, or overseas, and to live that life with safety—without acquiring infection from disease and without spreading disease to his comrades. In the second place, it is so designed as to show him a healthy way of life which will achieve real physical and mental health, in the hope that such knowledge as he may acquire and such habits as he may form will be carried back to civil life when he leaves the Service.

Various differing types of health training are given to the soldier throughout the whole of his service, but the bulk of the formal training is given during the "recruit" stage. Every man on entering the Army undergoes a course of training of six weeks' duration at a Primary Training Centre; this is a basic training, and during this period he undergoes selection procedure. The basic training and selection procedure completed, the recruit is posted to that arm

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of the Service which selection has indicated as being most suitable. He then undergoes a further, and more advanced, course of training at a Corps Training Centre which is also of six weeks' duration.

It is at these two training centres therefore that the young soldier receives most of his health education, and it is perhaps worth while to consider this training in some detail. The training is given by N.C.O. instructors. These instructors have themselves been carefully selected and given a very full training at the Army School of Hygiene—their training lasts two weeks and qualifies them to give health training at both Primary Training Centres and Corps Training Centres. A further provision made is that the officers commanding and seconds-in-command of both these types of training centre go to the Army School of Hygiene for a short series of lectures and demonstrations on the purpose and nature of the health training which is being given at the units under their command. The N.C.O. instructors work from a précis, or syllabus, and the précis for each lecture has been prepared with the greatest care by the medical department of the War Office in collaboration with the various military medical training establishments. Such a précis does not restrict the instructor to minute detail, and so does not tend to cause a "parrot-like" repetition, but it does lay down the factual content of the lecture to be given.

The scope of these lectures is rather different at each training centre. At the *Primary Training Centre,* the recruit receives four lectures each of about forty-five minutes' duration. These lectures deal mainly with personal hygiene, they aim at showing the benefits to be derived from the adoption of a healthy way of life and correct habits. They explain in detail the correct daily routine of washing, eating, sleeping and enjoyment of leisure; they explain the structure and functions of the body in very simple terms—including the function of reproduction; they conclude by giving a simple explanation of the causes of disease, the methods of avoiding disease, and place great emphasis on the value of immunization, inoculation or vaccination. They also draw attention to the work of those who are continually functioning to protect the community from disease—sanitary inspectors and other health workers. Each lecture is illustrated with a film or film strip and a list of the suitable films is included in the précis given to each instructor.

At the *Corps. Training Centre* the recruit receives six lectures each of forty-five minutes' duration. These lectures deal with communal hygiene and stress the relation of the soldier or citizen to the rest of the community, the services he receives from the community and his duties in return; whilst in the wider field of administration they include details of the military hygiene organization and its relation to civilian Public Health organization. They describe the methods of spread of disease, including droplet diseases, insect-borne diseases, parasitic infections, excremental diseases, venereal diseases and in every instance teach ways in which each individual can help to reduce these diseases. They also teach the simple individual methods for protection of food and water, details of correct communal habits, some elementary tropical hygiene (with a repetition of the value of special inoculations) and malaria

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prevention. There is some elementary nutrition taught and a short mention of dietary deficiency. The series of lectures concludes with an exhortation to make use of this health knowledge just learnt, to become "positive health conscious" and to pass on such knowledge to others, in the Army or in civil life, whenever the opportunity or occasion arises.

For Officer-Cadets.—So much for the formal health training of the recruit: with certain modifications a similar plan is followed for the further, and more advanced, training of officer-cadets. The training of these young officers is carried out either at officer-cadet training units, in the case of national service men; or at the Royal Military Academy, Sandhurst, in the case of regular officers. Before cadet training is commenced each man must have served at least six months in the ranks, and so the recruit's health training, as noted above, will therefore have been received by each cadet during this period of service in the ranks. The training given to the cadets can thus be built on this foundation, it is given a different bias and is of a much higher standard. It is designed to ensure, first, that the junior officer has a better knowledge of health matters than that which is required by the men under his command and secondly, to ensure that he is aware of the special responsibilities, with regard to promotion of health and prevention of disease, which he must assume once he is put in command of men. The training at both establishments is essentially the same but that at Sandhurst is longer and more detailed.

At the *Royal Military Academy, Sandhurst,* the cadet receives training in health matters for twelve periods each of forty-five minutes' talk followed by discussion. The scope of these talks includes a description of the working of the hygiene services of the Army, the officer's responsibility for his men, the care of the soldier, the mental health of the soldier, some basic principles for the prevention of disease, more advanced instruction in nutrition and the feeding of the soldier and, finally, an explanation of the importance of personnel selection and the wastage of manpower due to disease—with special reference to the lessons learnt during the last war.

At the *Officer-Cadet Training Units* the same course of instruction is given but it is, of necessity, compressed into six lectures of forty-five minutes each (instead of twelve). As far as possible the cadets are taught the more essential facts about their responsibility as officers, the care of the soldier and wastage from disease, in exactly the same detail as at Sandhurst but less time is taken up in descriptions of the preventive measures for each individual disease.

Informal Training

The formal training of the soldier, on the lines indicated above, is essential: it forms the basis on which all else rests, but while it teaches the simple rules of health and explains the reasons why certain things are necessary, this in itself is not enough. The formal lecture or talk must be followed up and "hammered home" by practical application in daily routine, and it is considered that this is just as important as the formal lecture. Having learnt correct habits as a recruit the soldier practises these habits in his daily

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routine—he must appear in public properly washed and shaved, he is able to bath regularly, he eats balanced, well-cooked and well-served meals, he must work hard, and on some occasions he is subjected to severe strain, but he also enjoys facilities for recreation and sport. The young soldier soon develops correct habits in relation to the community in which he lives; in this he is supervised and corrected by N.C.O.s and officers, but much more powerful is the herd instinct which compels conformity with the conduct and habits of the group in which he is living—and in the Army it can be ensured that the conduct of the group maintains a high standard.

It is well recognized by educationists that the mere learning of a lesson does not ensure knowledge, they agree that there must be repetition and also the bringing to bear of outside influences before the content of the lesson is retained and translated into habit or conduct. It is from this aspect therefore that the real value of the Army as an influence in health education must be judged. The recruit not only receives health training which has been carefully designed and properly delivered, but, in addition, his conduct is regulated throughout the rest of his service so that he daily puts into practice the high standards of hygiene which he has been taught. The communal life stresses the necessity for all to conform to a common code and it requires only a short while, as a rule, for the young soldier to develop the habit of living properly. This habit will persist as long as he remains in the Service. After he leaves the Service other influences may be too strong and he may forget these habits, but it can be safely assumed that some proportion, at least, will continue to maintain the standards they have acquired; whilst even of those who relapse the majority will retain some of their new habits and might even effect some change on their neighbours and friends before mutually reaching a common level.

In this type of informal training the Army Education Authorities play a large part. Their Education Officers and men take a great interest in the general topical and everyday education of the soldier and use an extension of the methods which proved such a success during the war. The ABCA publications have been replaced by a similar series called "Current Affairs" and the technique of instruction is the same as that used in wartime—the publication of the pamphlet, followed by a lecture and a discussion using the facts given in the pamphlet as a basis. As an example of the use of this method of teaching for health educational purposes one can quote the recent publication entitled "Fight Against Infection" [14] which deals with the infectious diseases, the work of Chadwick and the early sanitary reformers, the present position as regards prevention of infectious disease, vaccination, immunization against diphtheria and so on. It concludes with a plea for better health education in schools and for all citizens, and it gives a list of eight books for further reading by those whose interest may be awakened by the pamphlet, by the lecture or discussion.

In conjunction with these publications a series of wall maps are produced for use in unit information rooms and these often give a great deal of information

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on health matters, such as one excellent number on Food, Health and Children [15].

It is by such methods that information on health matters is presented to the soldier in a manner which facilitates easy and casual absorption and which includes in his general knowledge a certain amount of health education on matters which may be of topical interest.

Specialized Training

The health education which has so far been considered is that which is given to every soldier and officer, and because it is given on this 100 per cent basis it is undoubtedly the most important. But while this modicum of health training is given to every soldier, much more detailed and specialized training is given to certain special groups, of which the following is the most important:

Regimental or Unit Sanitary Personnel.—Specialized training is given, at the Army School of Hygiene, to what are termed "Unit Sanitary Personnel." It is laid down that in every unit of the Army a certain number of men must be trained in sanitary duties and water duties, whilst one or more officers shall receive hygiene training by means of a special Regimental Officers' Course. This type of training serves a dual purpose—it provides a number of men in each unit who have a certain amount of additional knowledge and who should be propagandists of the cult of health, whilst in addition it means that a certain proportion of soldiers receive a fairly advanced course of training which may benefit them later, in civil life.

It is regrettable that much excellent training of this nature is a waste of time and energy due to the fact that the units often send their most unsuitable men on hygiene courses—men of poor intelligence and limited ability. However as will be shown later in this paper steps are being taken to counteract this tendency, by making a knowledge of hygiene one of the requirements for promotion and increases of pay. It is also possible that unit sanitary personnel may eventually be given a higher status with a R.A.M.C. serjeant in charge.

Training in Tropical Hygiene.—This training is given to sanitary personnel who have been posted overseas as reinforcements and to the sanitary personnel of units proceeding overseas. Such training includes a great deal of anti-malaria instruction in addition to general tropical hygiene. Apart from these obvious differences the same considerations apply as have been noted for the general training of unit sanitary personnel.

Physical Training Instructors.—In the Army, physical training is taught by regimental soldiers who have received special training and also by personnel of the Army Physical Training Corps. Both types of instructor receive their training at the Army School of Physical Training and during this time they receive an intensive course on health matters including lectures and demonstrations on elementary anatomy and physiology and visits to the Army School of Hygiene. These instructors become some the most active propagandists of the need for living a healthy life, they themselves are so fit as to be a concrete example of, and advertisement for, bodily fitness and health whilst in addition

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they are teaching the young man useful arts or popular games such as boxing or football and so their words carry some weight with the pupil. It is therefore of the highest moment that such instructors are well versed in health matters—this, as has been shown, is ensured during their training and there is no doubt that some valuable work on health education is carried out by these instructors.

Substandard Recruits.—These are a small, but highly important section of the Army intake. Field-Marshal Lord Montgomery has stated that of the national service intake, of each group eligible, about 34 per cent would be below the standard required for the Regular Army—19 per cent would be unfit for the Regular Army and a further 15 per cent would be unfit for full military duties even as national service soldiers [16]. It has been found that of these unfit men a large number can be made fit after a carefully graduated programme of training, under medical supervision, at special physical development centres. These centres deal with recruits suffering from such defects as pes planus, bad posture, kyphosis, scoliosis, and the like—often accompanied by the effects of malnutrition and a poor general physique. The course lasts eight weeks and includes graduated physical training, special remedial exercises and a general educational programme, all of which are given by specially selected instructors. The results of such training are remarkable, about 71 per cent of the trainees are raised to a higher medical category, of which 69 per cent are upgraded to the highest category of A1; these figures are the results of experience with over 35,000 trainees [17]. In addition a recent follow-up of 2,000 men who had undergone a course at such a centre showed that after two years or more about 80 per cent remained in the higher medical category to which they had been upgraded, notwithstanding the fact that of the 20 per cent who broke down many had done so through injury or other diseases than that which caused their original disability [18].

At the present time provision is made for the training of 10,000 substandard recruits every year at one large physical development centre.

It is apparent that this type of training is health education in a very real sense, for these young men are literally trained back to health. The correction of faulty habits, instruction in the correct technique of healthy living, supervision of work and recreation plus graduated physical training—all these act together to make a fit young man from a weakly one. Such facilities should be open to every young person under the direction and guidance of the Ministries of Education and Health. It is to be hoped that, as soon as circumstances permit, this very valuable form of health education will be taken up by these civilian ministries and offered to all children or young persons.

Future Developments

The programme of health education which is in operation in the Army is, as we have seen, a comprehensive one, and there is little doubt that it is more than adequate for the task it has to perform. However, in spite of this, efforts are constantly being made to improve the system still further and consideration

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is given to new procedures or administrative measures likely to further this end, whilst new experimental ventures are continuously being tried. It is also inevitable that future changes in Army organization and training will have repercussions on the programme of health education. To illustrate the present trends two proposals under consideration may be quoted, and the effect of one major reorganization noted:—

Hygiene Qualification for Promotion.—After some discussion it has been accepted in principle that in future hygiene and sanitation will be included amongst the subjects for promotion examinations for the Regular Army. It will be necessary for all regular soldiers to pass such examinations before being promoted to Serjeant and all regular officers before promotion to Captain. Similarly under new rules now coming into operation a soldier's pay depends upon the number of qualifications he possesses according to the so-called "star-system." Under this system every combatant soldier both regular and national service, before he can qualify in the important subject of battlecraft, must satisfy the approving authorities that he is trained in personal hygiene.[1]

These rules for the "star system" of grading are already in operation. The rules affecting promotion will, it is hoped, be in operation in the near future. In either case the anticipated result will be to awaken a new interest in hygiene training and health education in the keen young soldier and junior officer. It is perhaps worthy of note that, as has been already mentioned, such a system was tried out with some success in 1908, although then it only affected officers whereas the present proposals embrace all ranks and affect both promotion and rates of pay.

Sex Education.—Three experimental courses in sex education have recently been carried out by the education authorities of London District. Both the Archbishop of Canterbury and the Secretary of State for War have approved these courses as an important preliminary to an Army-wide consideration of this vital subject. The first students were carefully selected from those about to be married, both military and A.T.S., and the lectures were given by experts from the Marriage Guidance Council. It is possible that before long soldiers or A.T.S. auxiliaries may be able to attend with their civilian fiancés, at lectures on the responsibilities of marriage. The immense benefits which will result from such lectures will be at once apparent, the great advantage of having them organized by the Army will be to ensure that each lecture is properly controlled and brought to the notice of an audience of young men and women preparing for marriage.

Reorganization of Training Units.—It is apparent that during the next few years many changes will be effected in the Army, its organization and particularly its training. It was announced by the War Office on October 14, 1947, that Primary Training Centres will eventually be abolished and each arm of Service will have Basic Training Units to which the recruit will be sent after a modified form of selection procedure, carried out before call up, has

[1]Army Council Instruction No. 721 of 1947, dated August 30, 1947.

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indicated the arm for which he is most suitable. This reorganization will inevitably affect the present system of health education, because, as we have already seen, the bulk of formal health training is carried out at Primary and Corps Training Centres. It has been decided that the future Basic Training Units will, in effect, be an amalgamation of the Primary and Corps Training Centres, but will give a course of training lasting ten weeks instead of the twelve weeks previously given at the Primary and Corps Centres. This new unit will therefore give the health training previously given at the present training centres. Such reorganization may necessitate certain administrative adjustments in the training programmes for the recruits' health education, but it has been agreed that the amount of this health training will be maintained at its present level and the full number of ten lecture periods will be allotted in the revised programmes.

Integration With Civil Organization

An attempt must now be made to assess the place of the Army's scheme of health education in relation to that which is being offered to the community as a whole, and also to indicate how the Army, together with the other Armed Services, has special opportunities for the training and education of the young men such as are not offered to any civilian organization.

Although there are many differences of opinion regarding the methods which should be employed the aim of health education is to bring to all, and especially to children at each stage of their development, the necessary knowledge to obtain a state of well being [9]. Any system of health education must therefore be based upon the intellectual level of the population, or any given section of the population, to whom the education is being directed. With this basic fact in mind, the Central Council for Health Education considers that at the present time health education should be directed along two lines [20]:—

(*a*) *A long-term policy* of health education based upon a gradually rising intellectual level of the whole community and which aims at presenting the facts to the people, whereupon they will of their own volition select the correct course of action to follow and so achieve a healthy way of life.

(*b*) *A short-term policy* which is based upon the theoretically less desirable principle of dogmatic education whether conducted on a planned or an *ad hoc* basis.

It is obvious that the long-term policy is dependent upon marked improvements in our educational system, which will not be achieved for several generations—in the meantime this type of health education must attempt first of all to "educate the educators." The primary need at the present time therefore is to concentrate on reaching a moderate standard of health education in the population as a whole, by more dogmatic teaching methods. In this connexion one should note that it has always been difficult to obtain accurate evidence of the intellectual standard of any given population, but that some data is now being accumulated by the Army from its figures on the intellectual ability of national service recruits. These recruits are a cross-section of the nation at the

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age level of about 18 years, and it has been found that of those who enter the Army, about 26 per cent are below the school-leaving standard of the elementary school [21]. This reinforces the argument that while the long-term policy of health education must be continued, the main need of the moment is for a wide and comprehensive system of dogmatic health education for the whole country. The Central Council for Health Education is the accepted organization for work along the lines of the long-term policy, concentrating on doctors, nurses, health visitors, teachers, youth leaders and industrial welfare workers—thus "educating the natural educators"—who will themselves spread the gospel of health.

The Local Authorities and Education Authorities will probably concentrate on the mother and the school child but will also try to give general health education from time to time. Various other agencies will deal with the broader aspects of film, broadcasting and press publicity in conjunction with the Central Council for Health Education [22].

There can be no doubt that the best agencies for the health education of the young man will be the Armed Services, during his period of national service, and the Army will deal with the majority of these young men. It is because of this period which most young men will spend in the Armed Forces that the health educational system employed therein is of such importance to the country as a whole. This fact is becoming generally recognized by informed opinion in both medical and lay circles, whilst the *Lancet* recently stated that: "The opportunity for promoting 'positive health' is nowhere greater than in the Armed Forces; for here, as in no other walk of life, groups of fit young men are brought together in an environment where they may be ordered, instructed or guided in the way they live" [23]. We can see, therefore, how the health education as given in the Army has its place in the overall scheme of health education for the nation as a whole, its particular importance and concern being the young national service man—who can be influenced and trained to health consciousness at a critical stage in his development just before he reaches full adult maturity. Furthermore, it must be realized that the Army, together with the other Armed Services, is in fact the only possible agency which can be sure of reaching the majority of young men of this age. It is therefore suggested that in any national system of health education the Armed Services, through their Medical and Educational Branches, should be recognized as the best agency for giving health knowledge and training to the young man until such time as our educational system provides adequate health education in the schools, and until some additional training is provided for those between the ages of 16 and 18 years.

One final point to be made is that whereas the same conditions obtain for the Service woman as for the Service man, the much fewer numbers of women involved means that, although the women's Services are powerful agencies for the education of the young woman in health matters, their influence in any national system must remain small, in view of the small proportion of young women to whom such training is available.

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Conclusion

The promotion of positive health in the soldier, the maintenance of such health and the prevention of disease are the primary duties of the Army Medical Service. In the furtherance of these duties the paramount and basic importance of health education is recognized, and a comprehensive programme of training in health matters, evolved over the past one hundred years, is given to each soldier commencing in his recruit days and continuing throughout his service. Subsequent to this training the soldier's environment is such that he may be ordered, instructed and guided towards a healthy way of life throughout his military service.

In addition to the purely military necessity for such health education the institution of national service has given the Army an opportunity to assist in the promotion of a better national health. With this end in view the system of health training has been reorientated since the end of the Second World War to place a greater emphasis on the duties of every citizen towards the promotion and maintenance of health, and as a result some excellent health education is now received by many thousands of young men every year. This much-needed health knowledge will be given by the Army, and the other Armed Services, to practically every young man in the country during his 18th year—the young men who could not in all probability be reached by any other educational agency. These young men having learnt a healthy way of life in the Services and having lived in such a healthy environment for a year or more, there is every possibility that this will persist, to a greater or lesser degree, after leaving the Service to return to civil life.

Summary

The system of health education in the Army has been discussed and an attempt made to show:—

(1) Its evolution and growth over the past one hundred years.

(2) The scope and nature of the training at the present time.

(3) The influence of a controlled military environment on the formation of habit.

(4) The beneficial effects on the health of the nation through the health education of the national service soldier.

(5) That the Army and the other Armed Services are the only certain agencies which can reach this important age-group of young men at the present time.

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[The Change in Selection Procedure mentioned in this article has now taken place.—Ed.]

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CURARE AS AN ADJUVANT TO ANÆSTHESIA IN MILITARY PRACTICE

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CURARE in various preparations has been in use as an adjuvant to anæsthesia since 1942 [1].

Unfortunately, supplies were not available during the war to enable it to be tried out under active service conditions.

The series presented in this article is that of 100 cases operated on in a large military hospital in the United Kingdom under peacetime conditions.

The preparation used has been "Tubarine" (Burroughs Wellcome)—tubocurarine chloride—and a constant technique has been employed throughout, for the most part associated with major abdominal surgical procedures.

Although no elaborate discoveries are claimed in this article, it was thought worth while publishing this series; as each case was carefully controlled with a B.P., pulse-rate, respiration-rate record.

TECHNIQUES

ABDOMINAL OPERATIONS.—Premedication was by alopon grain 1/3 (22·0 mgm.) and scopolamine grain 1/150 (0·44 mgm.) given one and a half hours prior to operation.

Induction was by pentothal sodium 3 to 6 mils. in a 5 per cent solution, followed by cyclopropane and oxygen in a closed circuit. Endotracheal intubation was performed in all cases; usually by the nasal route.

Dosage of curare: 10 to 15 mgm. of tubarine (B.W.) depending on the weight and general physique of the patient, was given intravenously synchronous with the first incision, followed by 3 to 5 mgm. as required by the needs of the surgical procedures, and repeated if necessary.

The maximum dose used in any one patient was 29 mgm. and the average dosage for each surgical procedure is shown in the accompanying table.

BRONCHOSCOPY AND OESOPHAGOSCOPY (Premedication as above).—Induction with pentothal sodium 10 mils. of a 5 per cent solution, followed by additional pentothal sodium given slowly to produce deep anæsthesia, consistent with adequate respiratory exchange; this amount varying between a further 4 and 8 mils.

Tubarine (B.W.) was then given intravenously in a dosage of 2 mgm. per stone body-weight, closed-circuit apparatus being at hand for artificial respiration with oxygen, should apnœa or undue respiratory depression occur. As soon as full curarization was effected (three to five minutes after injection),

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provided the respiratory excursion was satisfactory, the surgeon was allowed full access to the patient. Cocainization of larynx or pharynx was not employed.

Course of Anæsthesia

Respiratory depression was not a marked feature in this series, though typical jerky diaphragmatic respiration was observed in almost every case, and "aided" respiration was employed in all cases in which the respiratory exchange was judged to be below normal.

Full controlled respiration was required only in four cases, for periods of apnœa varying from five to fifteen minutes.

In no case was it found necessary to employ prostigmine as a respiratory stimulant.

Cases	*No.*	*Average age*	*Physical state* Good	Fair	Poor	Serious	*Emergency*	*Average duration*	*Average dosage of tubarine*
Partial gastrectomy	12	41	6	4	2	—	—	117 minutes	21·0 mgm.
Perforated peptic ulcer	6	30	3	2	1	—	6	60 minutes	16·3 mgm.
Intestinal obstruction	7	29	3	3	1	—	6	62 minutes	17·0 mgm.
Gastro-enterostomy ..	1	30	—	—	1	—	1	85 minutes	15·0 mgm.
Laparotomy	12	32	4	6	2	—	4	46 minutes	13·3 mgm.
Vagotomy ..	1	20	1	—	—	—	—	40 minutes	20·0 mgm.
Herniotomy	2	48	2	—	—	—	—	45 minutes	10·0 mgm.
Hysterectomy	2	35	—	1	1	—	—	88 minutes	11·7 mgm.
Splenectomy	1	19	—	1	—	—	1	75 minutes	22·5 mgm.
Partial colectomy..	2	20	1	—	1	—	—	120 minutes	11·0 mgm.
Cholecystectomy ..	2	25	1	—	—	1	—	65 minutes	15·0 mgm.
Nephrectomy	11	27	7	2	2	—	—	44 minutes	14·3 mgm.
Nephrolithotomy ..	4	26	3	1	—	—	—	60 minutes	15·0 mgm.
Uretero-lithotomy ..	2	22	2	—	—	—	—	43 minutes	12·5 mgm.
Transplantation of ureter	2	51	—	—	2	—	—	38 minutes	10·0 mgm.
Prostatectomy	9	51	4	4	1	—	—	51 minutes	12·4 mgm.
Renal sympathectomy ..	4	24	4	—	—	—	—	63 minutes	15·7 mgm.
Lumbar sympathectomy	5	30	4	1	—	—	—	61 minutes	15·0 mgm.
Appendicectomy ..	6	2	2	2	—	2	6	49 minutes	11·9 mgm.
Bronchoscopy	3	31	3	—	—	—	—	15 minutes	20·0 mgm.
Œsophagoscopy ..	4	27	3	—	1	—	—	20 minutes	18·7 mgm.
Laryngoscopy	2	23	2	—	—	—	—	10 minutes	13·7 mgm.
Total	100		55	27	15	3	24		

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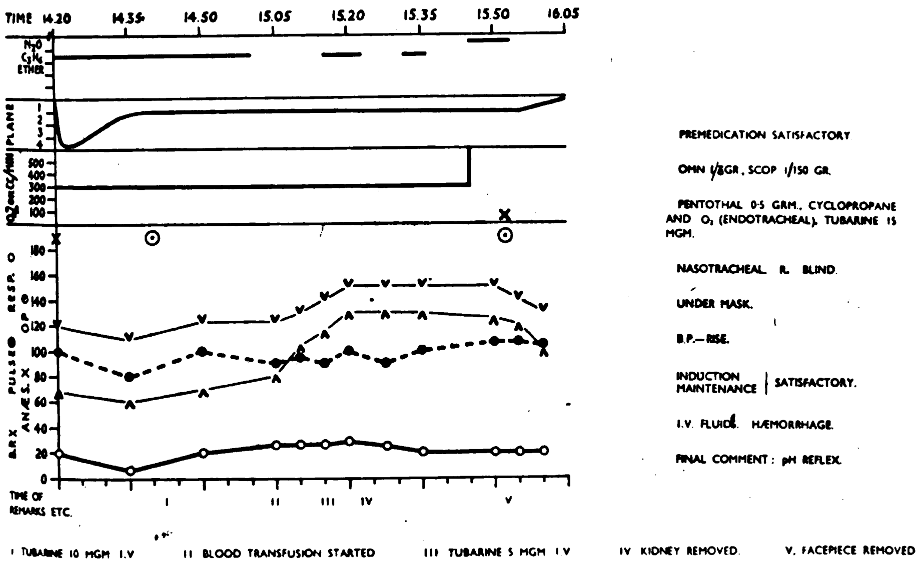
The plane of general anæsthesia in this series, excluding the endoscopies, was never below Upper Plane II of the third stage (Guedel), and the usual depth maintained was Lower Plane I.

Neither bronchospasm nor hypotension, as described by several authors, were encountered [2], [3].

In a few cases there appeared to be a tendency for the systolic blood pressure to rise during the later stages of a long operation, probably associated with inefficient ventilation and consequent CO_2 retention (Chart A).

CHART A.



Operation. Nephrectomy for traumatic rupture of hydronephrotic kidney. Note tendency for B.P. to RISE during second half of the operation.

Recovery of consciousness was rapid, the pharyngeal reflex being present in nearly every case before the patient left the operating table: full consciousness was recovered in fifteen to thirty minutes after return to bed.

A marked feature in these cases was the fact that operative stimuli which normally would be expected to produce some degree of operative shock had little or no effect on the patient's condition as assessed from B.P., pulse, and respiratory rate record (Chart B). In general, operating conditions were excellent. Respiratory movements were minimal, relaxation was complete, oxygenation was full and bleeding was not increased.

POST-OPERATIVE MORBIDITY

Deaths	Respiratory, Major	Respiratory, Minor	Circulatory	Alimentary
Nil	3	17	2	3

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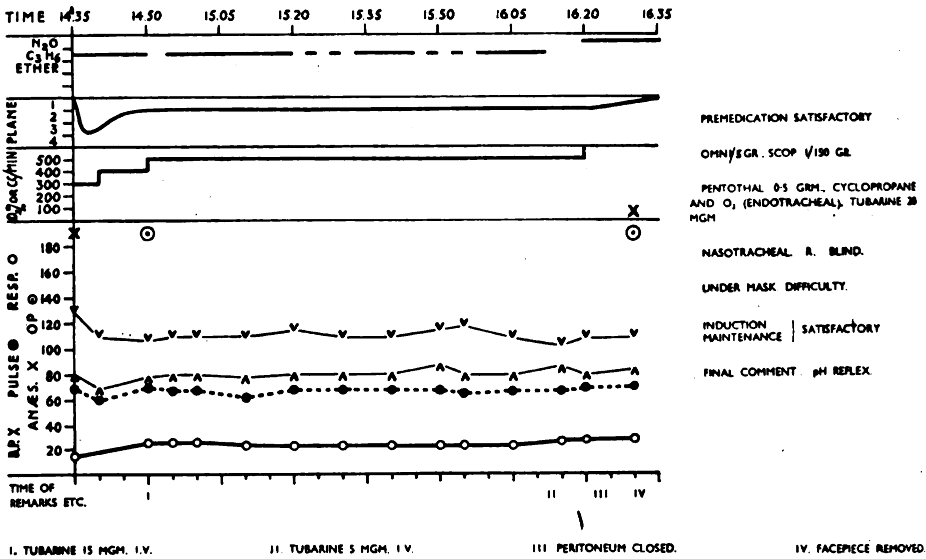
CHART B.



Operation. Partial Gastrectomy. Note readings unaffected by operative stimuli (traction on the stomach, etc.)

Respiratory Complications.—(*a*) Major: Of these one was a post-operative bronchitis following operation for closure of a perforated gastric ulcer, in a patient who already had an acute coryza; the second was a local atelectasis following nephrectomy; and the third, bronchitis due to inhalation of vomitus after uretero-lithotomy.

(*b*) Minor: These included upper respiratory catarrh, tracheitis, etc., all of mild degree.

Circulatory Complications.—Two cases showed evidence of circulatory collapse soon after return to bed, possibly due to the delayed onset of surgical shock following the cessation of the curarizing action of "Tubarine."

Both cases were treated by posture and the exhibition of vasopressor drugs, and showed complete recovery after two and a half hours.

Alimentary Complications.—Three cases developed post-operative ileus, one following laparotomy for acute intestinal obstruction, and two following partial gastrectomy: all made a full recovery. The incidence of post-operative vomiting was small.

REASONS FOR THE EMPLOYMENT OF THE CYCLOPROPANE—CURARE TECHNIQUE

Fakehany [4] states "Curare is most effective when combined with Cyclopropane."

This technique was employed by us for the following reasons:—

The type of patient, the average being a young or middle-aged man of good

physique, who required a powerful anæsthetic agent to maintain even a constant light third stage anæsthesia. 90 per cent of these patients were heavy cigarette smokers.

The ease with which "controlled" or "aided" respiration can be employed.

The high percentage of oxygen in the mixture, ensuring full oxygenation at all times.

The ease with which the depth of anæsthesia can be controlled. This is of particular importance towards the end of a lengthy operation, when, in order to have a conscious patient with adequate respiratory function and a protective laryngeal reflex on return to bed, it is preferable to obtain relaxation by deepening the anæsthesia, rather than by the administration of more curare [5].

The low post-operative morbidity, particularly the low incidence of major respiratory complications which so commonly occur after abdominal operations in military patients, particularly heavy smokers.

Contra-indications

It is emphasized that this technique, or indeed any technique involving the us of curarizing agents, should never be attempted unless the anæsthetist is familiar with the use of "aided" and "controlled" respiration, and is equipped with adequate apparatus to enable him to perform this when required.

In our small experience we would like to sound a warning against the employment of curarizing agents in any case in which a steep Trendelenburg position is employed by reason of: The danger of adding severe respiratory embarrassment due to the posture to the respiratory depression inevitably associated with curare. The possibility of costo-clavicular compression of the brachial plexus from the employment of shoulder rests in a heavy patient in the presence of the extreme muscular relaxation produced by the curare.

Other Curarizing Agents

Myanesin (B.D.H. Ltd.) has been employed by us in nine recorded cases (not included in the above series), but its use was not found to be entirely satisfactory on account of:—

(1) Variability of effect.

(2) The need for repeated serial injections, often irksome to the surgeon.

(3) One case of hæmoglobinuria occurred in the post-operative period and in view of the recent reports [6, 7] it was decided to discontinue the trial of this drug for the present.

Summary

A series of 100 cases is presented, in which curare was used as an adjuvant to anæsthesia.

Reasons are given for the employment of a constant technique in military practice.

Highly satisfactory operative conditions, rapid post-operative recovery, and a low post-operative morbidity are evident in this series.

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A warning is given against the use of this anæsthetic technique by other than experienced anæsthetists, equipped with adequate apparatus.

Our thanks are due to Colonel J. A. Crawford, Officer Commanding, Cambridge Military Hospital, Aldershot, for his kind permission to send this article for publication, and to Captain J. K. Sugden, R.A.M.C., who was responsible for a number of the administrations.

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MARCH HÆMOGLOBINURIA—A REVIEW

BY

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March hæmoglobinuria is a condition in which, as a result of exercise, urine is passed containing hæmoglobin in solution. Although uncommon, it is of importance because of its occurrence in young soldiers and its benign nature. The clinical history of the condition enables it to be readily differentiated from other causes of hæmoglobinuria, which may be of a more serious nature.

Hæmoglobinuria after exercise was first reported by Fleischer in 1881 [1] and later received the name "march hæmoglobinuria" because many of the cases occurred in soldiers, with marching as the common cause. In 1941, Gilligan and Blumgart [2] reviewed the literature, in which 40 cases had been reported, and described 3 new cases. They also gave the first quantitative description of the condition. Since then 12 new cases have been reported, making a total of 55 cases since the condition was first described.

Clinical History

March hæmoglobinuria has so far been described only in healthy males, usually adolescents, of ages varying between 16 and 35 years. They are either soldiers, athletes or people fond of vigorous exercise. The attack is brought on by marching, running or vigorous walking in the upright position. When the bladder is next emptied, following this exercise, the urine is seen to be red. The passage of red urine may last several hours after the exercise has stopped, but seldom for more than four or five hours. There are no abnormal signs and symptoms during the period of exercise or later, but some of the subjects complain of a vague, dragging pain in the back or groins, or of abdominal discomfort. Because of this lack of symptoms, it is unusual for the subjects to associate the red urine with exercise. They show no ill-effects from their hæmoglobinuria.

It is always possible, in these subjects, to bring about an attack by an appropriate amount of exercise. After a stay in hospital it is frequently found that the amount of exercise needed to produce hæmoglobinuria has to be increased and, eventually, no hæmoglobinuria can be produced, even by severe exercise. This remission may be permanent, as far as one can tell, or may last several months. During the course of long-standing cases, spontaneous remissions for intervals of up to two years may occur, but in the majority of the

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cases, the condition appears to run a course of several months and then disappear spontaneously.

The red colouration has been shown by several observers [2, 3, 4] using spectrophotometric methods, to be due to oxyhæmoglobin and not myoglobin, showing it to be derived from red cells and not from muscles. The condition is a true hæmoglobinuria, with no red cells, or, at the most, a very occasional one in the deposit.

The posture of the subject during the exercise is of fundamental importance as the hæmoglobinuria occurs only when the exercise is carried out in the upright position, as in running or walking. Other physical activities, for example cycling, are without effect. Using a bicycle ergometer, Gilligan and Blumgart [2] produced no hæmoglobinuria in one of their patients, with an amount of exercise more than enough to produce it when expended in walking. Both the exercise and the upright posture are necessary. Standing still in the upright position, and vigorous exercise while recumbent are also without effect. These investigators tested the effect of body position by another method. A plaster jacket was constructed which imposed a moderately kyphotic posture in one of their patients. He then walked for thirty minutes on a treadmill without the production of an attack of march hæmoglobinuria. The same degree of exercise, in an upright position, without the plaster jacket, resulted in a typical attack.

Clinical Findings

The patients are healthy, of normal physique, and have no postural defects. There are no demonstrable abnormalities in the genito-urinary tract. Anæmia is uncommon, the amount of blood lost in each attack being less than 20 c.c. as a rule, but it may be the presenting symptom when the attacks are frequent [5]. The spleen may be palpable in a few cases, but the liver is rarely enlarged.

Laboratory Findings

Urine.—There are no abnormalities except during the attack, when proteinuria, as well as hæmoglobinuria, may occur, more protein being excreted than can be accounted for by the hæmoglobin turned out. Occasionally, protein may be excreted for a short while after the hæmoglobinuria has stopped. Urobilinogen excretion is normal.

Blood.—Red cell counts, hæmoglobin, white cell counts and differential counts are normal. The fragility of the red cells measured before, during and after an attack, lies within normal limits. The fragility of the red cells to trauma, measured by agitating a suspension of washed cells in saline, is normal. Reticulocyte and platelet counts are normal. Jaundice is uncommon, but plasma bilirubin is often raised during and after an attack, increasing by 0·5 to 1·0 mg. per 100 c.c. Renal function tests are normal.

The only consistent departure from normal is in the level of plasma hæmoglobin. In normal people, at rest or during moderate exercise, the amount of hæmoglobin dissolved in the plasma is about 5 mg. per 100 c.c. and never

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exceeds 10 mg. per 100 c.c. In subjects showing march hæmoglobinuria, the plasma hæmoglobin is normal between attacks but rises sharply as soon as exercise starts [2, 3, 5, 6]. Hæmoglobin appears in the urine when the renal threshold is exceeded and persists as long as the plasma hæmoglobin is raised above this concentration, which may be for many hours.

The renal threshold for hæmoglobin in normal people is about 100 mg. per 100 c.c. [2] but in all cases of march hæmoglobinuria is much lower, often about 20 mg. per 100 c.c. This lowered threshold is not brought about by the exercise as injection of hæmoglobin solutions in these cases, while at rest, results in hæmoglobinuria when the plasma hæmoglobin is below 50 mg. per 100 c.c., showing that a low renal threshold is a feature of the condition. A typical example is: Plasma hæmoglobin at rest 9·9 mg. per 100 c.c.; after one hour's walking and running, during which 6 miles was covered, the plasma hæmoglobin was 227 mg. per 100 c.c. There was marked hæmoglobinuria lasting several hours.

It is now apparent that the sequence of events in march hæmoglobinuria is first, an increase in plasma hæmoglobin brought about by exercise in the upright position, and secondly, hæmoglobinuria. The rise in plasma hæmoglobin and the amount of hæmoglobin excreted in the urine correspond to the loss of about 20 c.c. of blood.

Differential Diagnosis

The diagnosis of march hæmoglobinuria depends on:

(1) Showing the absence of red cells in the urine.

(2) Identifying the urinary pigment as hæmoglobin, proving the condition to be a true hæmoglobinuria.

(3) Demonstrating an increase in plasma hæmoglobin during the attacks.

(4) Showing the relationship of the hæmoglobinæmia and hæmoglobinuria to exercise.

(5) Eliminating other causes of paroxysmal hæmoglobinuria.

The identification of the urinary pigment as hæmoglobin can be carried out by the benzidine or guaiac reaction and spectroscopically. Plasma hæmoglobin can be measured by the method of Bing and Baker [7, 8] or can be detected by naked eye by noting the colour of the plasma. A definite pink tinge is present in plasma containing over 30 mg. of hæmoglobin per 100 c.c. Blood must be drawn so as to avoid artificial hæmolysis and this is best done by using an oiled syringe and heparin as an anticoagulant.

The other causes of paroxysmal hæmoglobinuria to be excluded are:

(1) Exposure to cold (syphilitic type).

(2) Hæmolytic anæmia with nocturnal hæmoglobinuria (Marchiafava-Micheli disease).

(3) Paroxysmal myoglobinuria.

(4) Acute infections, burns, drugs, malaria, favism. This group can be readily excluded and will not be considered further.

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Exposure to cold (*syphilitic type*).—In this condition a hæmolysin is present which produces hæmolysis when the blood is cooled. It can be recognized by means of: (*a*) Wassermann Reaction and Kahn test; (*b*) Rosenbach test, positive if immersion of an arm or leg in ice-cold water for ten minutes or longer produces hæmoglobinuria; (*c*) Donath-Landsteiner reaction which detects, *in vitro,* the presence of a cold hæmolysin; (*d*) a history of attacks following exposure to cold.

In march hæmoglobinuria hæmolysins are absent and the last three tests are always negative.

Marchiafava-Micheli disease is associated with a chronic hæmolytic anæmia, the red cells being hæmolysed mainly at night, giving rise to a deeply coloured early morning specimen of urine. In this condition the red cells are very sensitive to slight changes in the acidity of the plasma [9].

Paroxysmal myoglobinuria can be distinguished by identifying myoglobin in the urine. Although it closely resembles hæmoglobin, the two can be differentiated by spectroscopic means. It is extremely rare in man and is frequently fatal. Fever and paralysis usually occur.

Treatment

As the condition is benign and usually clears up spontaneously, there is little that one need do, apart from limiting the amount of strenuous exercise to be done and treating any anæmia present. Hoffman [10] reported improvement in his case following ascorbic acid administration and more recently, Lubran and Sakula [5] reported apparent cures in three patients treated with large doses of ascorbic acid. However, Palmer and Mitchell [3] failed to influence the severity of the attacks in their patient, by similar treatment.

Ætiology

The exact cause of march hæmoglobinuria is unknown. It is not familial or associated with past illness or trauma. It cannot be due to a circulating hæmolysin produced by exercise, as all tests to demonstrate hæmolysins have proved negative.

The condition is unrelated to orthostatic albuminuria, although posture is an important factor. Cystoscopic examination of patients shortly after an adequate spell of exercise shows red urine issuing from both ureters, whereas in orthostatic albuminuria only the left kidney produces urine containing albumin. Further, between the attacks the urine of all the patients is normal and contains no albumin or blood. The patients, considered as a group, do not show the postural defects common in orthostatic albuminuria.

There is no evidence to suggest that there is venous stasis in any organ, e.g. liver, kidneys or spleen, resulting in hæmolysis there.

It has been suggested that the condition is an exaggeration of the normal, physiological response to severe muscular exercise in which, it is usually stated, casts, red cells and albumin may appear in the urine. An examination of this point was made by Gilligan, Altschule and Katersky [11] who investigated

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marathon runners and other athletes running distances between 2·6 and 26·2 miles. Of the short-distance runners, about half showed a slight increase in plasma hæmoglobin above the normal, whilst over three-quarters of the marathon runners, who covered 26·2 miles, showed a greater rise. The majority of them had a transient albuminuria and the urine contained a few hyaline and granular casts. Three showed some hæmoglobinuria. There was no connexion between hæmoglobinuria and build, age, training or standing position. The plasma hæmoglobin values rapidly returned to normal. All blood investigations on these subjects, including red cell fragility, were normal.

These experiments show that severe physical exercise is associated with a rise in plasma hæmoglobin, but throw no light on the mechanism of its production. In march hæmoglobinuria, the amount of exercise required to produce an attack is not necessarily severe, and much higher values of plasma hæmoglobin are often reached than in normal people following severe exercise.

Palmer and Mitchell [3] suggest that the cause of march hæmoglobinuria is not an increased hæmolysis, but a failure of the tissues to remove quickly enough, during exercise, the hæmoglobin resulting from the normal breakdown of effete red cells. This results in a raised plasma hæmoglobin, leading to hæmoglobinuria when the renal threshold is exceeded. Their suggestion seems improbable for many reasons, especially as the rate of increase of plasma hæmoglobin, in an attack, is greater than can be accounted for on their hypothesis.

The authors [5] have put forward the suggestion that, in cases of march hæmoglobinuria, there is a discharge into the circulation of blood from the spleen during exercise in the upright position. It has been established [12] that splenic blood shows spontaneous hæmolysis, *in vitro*. The hæmolysis of 30 to 40 c.c. of blood would be sufficient to account for the observed rise in plasma hæmoglobin in attacks of march hæmoglobinuria. It is suggested that, in normal people, the spleen discharges red cells into the circulation only after very severe exercise, as in marathon runners, but in subjects showing march hæmoglobinuria, the spleen is more readily stimulated and responds to a smaller degree of exercise. This is, perhaps mechanically, associated with the upright posture. There may also be an altered sensitivity associated with ascorbic acid deficiency. The quantity of splenic blood discharged would be too small to be detected by the usual techniques for red cell fragility determination.

Conclusion

Although march hæmoglobinuria is, according to published reports, an uncommon condition, it is probable that many undiagnosed cases occur, especially among young soldiers. A number of cases may be missed because the patients do not produce the hæmoglobinuria whilst in hospital and because many subjects passing red urine do not associate it with exercise. However, a careful history should always make the relationship apparent.

Once the condition is diagnosed, no further hospitalization is necessary and the patient can be returned to full duties. If these involve marching or running, as in training units, it is suggested that the patient be given 100 mg. ascorbic acid daily.

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MORBID CONDITIONS OF THE KNEE-JOINT IN EAST AFRICAN ASKARIS WITH PARTICULAR REFERENCE TO ÆTIOLOGY AND PATHOLOGY

BY

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DURING the period July 1943 to December 1946—nearly three and a half years—almost 300 trained men and some 33,000 days of service were lost amongst the Africans in the the East Africa Force due to diseases and injuries in, and around the knee-joint.

The following general ideas on ætiology and pathology emerged following survey of available information on these cases.

INCIDENCE

The total of admissions for this type of lesion, investigated, was 1,029 and the comparable total of hospital admissions about 16,000, i.e. approximately 6·4 per cent.

In a very much smaller series of Europeans, the figure was 4 per cent. These, however, were not comparable—too many varying factors affected admission to hospital and exposure to injurious influences outside—thus the African tended to be admitted for certain minor conditions and investigations, which would have been dealt with as an out-patient in the European who, on the other hand, while in Africa, was seldom called upon to exert himself physically, to the same extent as the African.

In Somali patients the incidence was 3 per cent, no doubt due to the facts that he was primarily a foot soldier, and was little exposed to strain from heavy gear, etc., and that he was not addicted to football to the same extent as the Bantu askaris.

NATURE OF THE LESION

From a detailed analysis of all the lesions, the following main types stand out.

Traumatic synovitis	*Osteo-arthritis*	*Tears of ligaments*	*Infective arthritis incl. V.D.*	*Bursæ*	*Wounds and abrasions*	*Hysteria*	*Various*
40%	15%	9%	6%	5%	5%	3%	17%

The synovitis group, the most important, was found to be composed of the following types:—

Type of synovitis	*Traumatic* *Hæmorrhagic*	*Traumatic* *Non-hæmorrhagic*	*Non-traumatic*	*Traumatic hæmarthrosis*
Mild acute (10 days) ..	2	60	24	12
Acute (10–40 days) ..	7	89	40	
Recurrent (>2 times) ..	1	62	4	
Chronic (>40 days) ..	5	62	31	

and the osteo-arthritic group of

(*a*) Post-traumatic	66	
(*b*) Non-traumatic	53	(17 bilateral)
(*c*) Secondary	4	
(*d*) Osteo-arthritis dissecans	6	

Ætiology

The effect of various influences thought to have causal relationship are discussed below.

Anatomical.—Dissection of twenty knee-joints, in ten subjects, gave the impression that the cruciate ligaments were longer and finer than in the European, but otherwise similar. Observation in the living confirmed the known anthropological features that: The negro has a longer leg, *in toto*; the lower leg is relatively longer and the calcaneus is more projecting than in the European.

Lewis, in the Biology of the Negro states "that the ligaments of the African knee are longer and slimmer, and that the Negro has a greater movement and the White a greater stability." He also opines that the cartilages of bone ends, e.g. femur, are of finer construction and more advanced.

Physiology.—The range of movement in the African knee, as observed in the normal subject, in the anæsthetized, and in the recently deceased, and compared with a series of Europeans, was found to be greater, and of the following order in the various directions.

Antero-posterior	½ inch
Lateral deviation	5—7 degrees
Hyper-extension	7 degrees
Patellar mobility	very mobile

Heredity has thus provided the African with a knee-joint having certain characteristics.

It is mobile, dependent for stability on muscles, their readiness for action, and the adequacy of that reaction—eminently suited for the regular, rhythmic strain of his usual life, e.g. work in the fields, travel by foot, tribal dances, etc., but too dependent on muscle protection to be suitable for the heavy, irregular unexpected strains of military life or sport.

There is longer leverage than the European, causing greater damaging force from a similar strain and, further, requiring greater protective reaction from muscles to control and counteract this force.

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He has a leg which should have more fluid in the joint normally, and excess more often, because it has a greater range of movement, and this normal movement is the stimulus to the production of synovial fluid. Further, its greater dependence on muscles renders minor traumata more frequent, thus increasing the fluid and the readiness with which it is produced in response to any stimulus.

If it is more advanced developmentally, as suggested above, it will follow the usual rule—the more advanced, the more liable to derangement.

Trauma

This had an obvious relationship in many cases, and is of particular interest in the two commonest lesions. Thus:—

In Synovitis.—*Degree of Trauma*: There was no definite relationship between the severity of the injury and the resultant synovitis, nor yet to the presence or absence of blood in the effusion. Nor was this discrepancy due to any underlying pathology, e.g. yaws, syphilis, or dysentery.

Time.—This was usually from one hour to one year previously, but ranged up to fourteen years in one case, without demonstrable arthritis, or recent injury.

Repetition of Trauma: This was reported in only a minority of the cases, and recurrence was usually due to strain or exercise insufficient to reach consciousness.

Nature: 30 per cent football; 40 per cent a fall on the knee—training, playing games, P.T. or during transport; 18 per cent striking the knee—as at work or in a fracas, etc.; 12 per cent twisting the knee—as on a parade or training ground or during games. The common factor to all was a sudden strain, irregularly applied with the muscle caught unawares—the force itself usually being insufficient to cause damage to an "aware" joint.

Occupation.—Incidence was directly proportional to the severity of the work or training performed, and varied from Infantry and Labour Corps on one hand to the Dental and Signal Corps on the other. The E.A.A.M.C. came unexpectedly high, due to playing football without adequate training, or lack of general hardiness.

Period of Service: Frequency was almost equal in those with one, two, and three years' service, by far the largest groups.

Rank: 91 per cent were privates, while above Serjeant such lesions were almost non-existent, i.e. they occurred in those directly exposed to the stresses and strains of Army life.

Seasonal Incidence: In the First World War in the Middle East such injuries were most frequent in summer, coincident with the period of "summer idleness." Curiously enough, the summer quarters in 1944 and 1945 showed the highest incidence. The hot season did not, however, correspond to our own summer, though in some parts activity or lack of it may have done so.

Intelligence: With its accompanying general awareness, and activity of protective reflexes could not be demonstrated as a factor of safety. We were, however, of the opinion that the African was not so much on his guard, against

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unexpected strain, as those who had been brought up in constant awareness of the possibility of injury from many sources, as in industrial or town life. He often became injured, even the same way, twice.

In Osteo-arthritis.—Trauma seemed to have a major causative rôle, 60 per cent of cases being clearly post-traumatic, while in the non-traumatic group 50 per cent were in the main occupational classes affected (Infantry, Labour and Service Corps) suggesting that strain or over-use plays an important part.

A further influence was the "squatting" position adopted by the African so frequently, for such long periods, which may affect the joint in the following ways, predisposing to disease or modifying it.

Localization of pressure: In standing the largest area of joint surface is comfortably engaged, in sitting, pressure is minimal, whereas in squatting, the posterior aspect of the femoral condyle and menisco-tibial surface are involved making a greater pressure on a more limited area.

Vascular: The popliteal vessels must be kinked acutely, probably diminishing the blood supply to the joint through the geniculate arteries.

Ligamentous: The patellar ligament and capsule attached thereto, must be at full stretch for hours on end, leading to ultimate lengthening, and therefore relaxation, in the extended position, making the joint more dependent on muscular control for stability and allowing repeated minor traumata to occur. Further, the long anterior fibres of the medial collateral ligament acquire a greater antero-posterior glide than normal in flexion, and the frequency of the extreme position must stretch the attachment of the ligament to the medial meniscus, so that both ligament and cartilage are less fixed and dependent on one another in function and in trauma. Due to this, and to the general laxity of the ligaments, which allows bruising of the cartilage and strain of the coronary ligaments rather than tears of cartilage, meniscal lesions are very uncommon.

Venereal Diseases.—These were commonly supposed to be a frequent cause of pathology in the knee-joint but, in this series, the relationship could be shown in only 3 per cent of lesions (gonococcal 1 per cent, syphilitic 1·8 per cent). As far as could be ascertained in V.D. centres the incidence of knee-joint complications seemed to be of the order of—gonococcal ½ to 1 per cent and syphilitic 1 to 2 per cent.

The usual range, given for Europeans, is 2 to 5 per cent suggesting a greater immunity and a lower grade of infection in the African. The criteria used in assessing the origin as venereal, vary. For the purpose of diagnosis, it was thought: In suspected gonorrhœal cases, the only finally reliable test was the finding of a positive genito-urinary lesion. The gonococcal complement-fixation test, the use of presumptive lesions, presence of pus in the prostatic smear, etc., were, for various reasons, regarded as unsatisfactory and conditions diagnosed on these criteria frequently failed to respond to the therapeutic test. In suspected syphilitic cases, one of the combinations listed was required—either a confirmed past, or definite recent history of syphilis, now having a Kahn test (+ +) or greater; or a Kahn test (+ + +) or greater, and no sign of yaws; or the

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demonstration of spirochætes in any associated lesion, e.g. ulcers, etc.; and the definite local characteristic of painlessness (except in arthralgic cases which seldom came to the surgeon).

Psychogenic Causes.—Almost 3 per cent were classified thus:—

(1) Hysteria—sensory (pain, paræsthesia) ... ... 1·4 per cent
(2) Post-traumatic neurasthenia (pain, loss of function, following definite trauma) ... ... 1 per cent
(3) Hysteria—motor (gross limp, paralysis, spasticity etc.) ... ... 1 per cent

In addition definite hysterical exaggeration, or prolongation of symptoms was present in about 10 per cent of cases.

To summarize: 75 per cent of morbid lesions in the African knee were directly due to trauma, and many others influenced by it.

In 70 per cent of cases this occurred during the inevitable strain of military labour, transportation, training, and manœuvres.

The remaining 30 per cent were due to football or allied games, and as such could have been completely eliminated, in theory, by banning these games, but impracticable in practice, as the value of football was so great in many other ways.

Pathology

Three factors were of greater significance than in the European:

The Production of "Internal" Keloid.—The African was liable to keloid formation following injury or division of fibrous tissue, even in minor ulcers, abrasions, bruises or after injections. Similar excess fibrous tissue reaction probably occurred in such conditions as torn lateral ligaments, capsular tears, nipping of synovial membrane and infrapatellar pad of fat, in diseases like villous and osteo-arthritis and, of course, in the formation of adhesions. Thus, for example, following the not uncommon tear of the internal lateral ligament excess fibrous tissue causes formation of adhesion from ligament to capsule, resistant to manipulative treatment, and a mass which involves medial geniculate nerve, causing pain.

The frequency of *nipping of the infrapatellar pad of fat* as a probable primary pathology in many joint lesions, especially traumatic synovitis. Such nipping being due to a momentary delay of the quadriceps muscle (relaxed by much squatting, by hysterical inhibition due to some minor bruise or capsular tear, or just responding sluggishly from "unawareness") in pulling the pad out of the way, when the need for movement arose suddenly.

This would account for strains, twists, stumbles and falls being the most frequent cause, not severe blows: and also for the lack of direct relation between degree of trauma and the reaction produced.

In favour of this primary lesion are the facts that most of the patients, once the general symptoms had subsided, complained of an ache below the patella,

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accompanied by definite tenderness on either side, and at a varying distance from it—all exaggerated on extension. If actual thickening accompanied this picture, the condition was classified as a bruise of the pad.

In two cases in which it was doubtful if the cartilage was damaged, at operation, no meniscal abnormality was found but there was recent hæmorrhage into the infrapatellar pad.

In the post-mortem examination of ten subjects, three were found to have bilateral tags originating from this pad of fat, varying in size, from 1/3 to 1/2 inch, in number, from 2 to 4, and in consistency from hard avascular to soft hæmorrhagic, yet there had been no history of significant knee lesion.

The sequence in both traumatic and non-traumatic synovitis cases was probably—mild nipping—effusion—further laxity of ligaments—greater liability to nipping, etc.

The *presence* of *a direct or accessory psychomatic element*, in many cases —mainly an inhibition, accompanied by limp, disuse, and later atrophy of quadriceps; this sometimes followed upon very minor lesions, perhaps not even connected with the leg—thus the African sought refuge in a limp in such conditions as inguinal adenitis, epididymo-orchitis, lumbar fibrositis, etc. Organic causes for similar atrophy occurred and required exclusion, e.g. old poliomyelitis, progressive muscular atrophy, chronic pyomyositis and that following such injections as quinine.

Other pathological conditions which may be mentioned for interest were as follows:—

Meniscal lesions — for their rarity (as mentioned above)

Pellegrini Stieda's disease Osgood Schlatter's sprain Osteo-arthritis dissecans.	for their frequency, each about 1 per cent.

Chronic villous hypertrophy (synovitis or arthritis) for presenting as an apparent entity. which though without pathological basis appeared clinically as follows: Diffuse thickening, limited to the synovia; gross, hard crepitus, suggesting articular involvement; yet. normal X-ray or the appearance of intra-articular soft tissue and negative findings in various specific tests.

No evidence could be found that these cases were the precursors of tuberculosis, the products of syphilis, nor yet the lipomatous stage of osteo-arthritis. Twenty-two cases were put into this category. A number of these were almost certainly examples of chondromalacia patellæ—a degeneration of the knee-joint in young people, the description of which has been so thoroughly presented recently—Gray (*B.M.J.*, March 1948) and of which we were inadequately conscious, to make the diagnosis, prior to this.

Guinea-worm infestation for being the explanation behind a number of puzzling cases.

Other individual examples of pathology due to these various causes were seen—yaws, dysentery, filariasis, septic foci, nervous diseases, diaphyseal aclasia. pyomyositis, bilharzia (associated), mycosis, cysticercosis, exostosis, chondroma. chondrosarcoma, peri-articular fibrosis, Sudeck's atrophy and thrombophlebitis.

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Treatment

Almost 25 per cent of native soldiers, with disability of the knee, had to be boarded, while most Europeans could return to their duties. Further, using uncomplicated traumatic synovitis to compare the duration of treatment, it was found that the average stay in hospital of an African was twenty-two days, that of a European fifteen—tending to confirm the impression that treatment was less successful in the African. There was, however, less difference than the above suggests as the degree of function required in the African was greater, in view of the physical needs of his service, compared with those demanded in the semi-supervisory capacity of the European.

Treatment in each case was along orthodox lines, seldom operative, and rehabilitation facilities were satisfactory, so the difference must have lain in other spheres and indeed was much influenced by the psychological elements in his environment as indicated below.

The key to maintenance, or restoration, of stability, function, protection, and freedom from symptoms, in this joint—particularly in the three main causes of disability—lay in the correct action of the quadriceps group of muscles. The prophylactic and therapeutic handling of this muscle, demanded a very considerable effort of will, and co-operation on the part of the patient. Diminution or collapse of this exercise of will-power and concentration was readily brought about by numerous influences and ideas, some seeming nebulous or even fatuous, yet, if the African mind was disturbed by even one of these, delay or failure of restoration of muscle balance and compensation tended to result.

These factors were either:—

In his attendants.—Failure to understand the African due to the "white sahib" attitude, to laziness or lack of interest. Failure to grasp the vital need for rehabilitation, introducing that element of doubt in the air which allowed the African to slip back into passive lethargy. Failure to regard the African worth all the sustained effort required—he seemed such a poor economic and even military unit, so easily replaceable, so easy of disposal—into the bush.

In the African himself—mainly in his mental perspective. Thus, the fact that he was not supported by the European's grasp of and concurrence in the need for war or service in the forces (despite the best endeavour); the fact that the injuries occurred in association with unusual agents, e.g. tanks, guns, organized games, etc., made him feel that they must be worse than those he knew at home, causing the injured leg to become an object of detached interest to him and the muscles to be so completely flaccid, that only the most strenuous efforts could obtain even the tiniest flicker of their fibres; the difficulties of language and his incapacity to grasp semi-abstract thoughts or instructions; his feeling that a "native" doctor could really "get at the roots" of the trouble; his naturally easy-going temperament combined with the reduction of the usual fatigues, in hospital; his fear of ultimate social and economic inadequacy, and often worry due to loss of contact with his own home when away from his own unit; and, finally, his firm belief that he should

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not exercise his leg to improve it, but that when it "felt good" he would walk on it easily.

All combined to render him most resistant to attempts to enlist his co-operation in the necessary physical regime. Each of these difficulties and doubts must be vigorously and consciously countered, by explanation and appropriate action and the highest psychological "boost" maintained at all stages of treatment, by all grades of his attendants.

Certain points of interest emerged from the actual details of treatment, e.g. damaged cartilages were best accepted as an indication for boarding—operation seldom returned them to satisfactory duty.

In refractory effusions, before the final decision to board, it was worth trying either, reduction of the fluid intake to below 12 oz. daily for three to four days, as sometimes if the body needed fluid, it would take it from the knee, or a period of three weeks' ambulation, following the aspiration of the fluid and application of a firm pressure bandage, and plaster of Paris in the almost completely extended position. On removal of the plaster, no recurrence was then found in about 30 per cent of cases.

Intra- or extra-capsular loose or foreign bodies, including those of osteoarthritis dissecans were worth removing—giving relief from symptoms, with a surprising freedom from post-operative psychogenic disability.

The only other noteworthy cause of delay in instituting treatment was the African's willingness to wait up to fourteen days, before reporting sick with the various swellings and infections in the joint region, if not accompanied by severe pain.

Study of the various causes, effects, and difficulties in treatment of such knee-joint conditions, suggests the following measures, which, if stressed more than formerly, might reduce the morbidity therefrom.

Prophylactic.—Insistence on great care in the driving of personnel trucks, and instruction in safe methods of en- and de-trucking.

Insistence on preliminary training before organized games, heavy physical training, or field exercises, and the acquisition of controlled skill in them rather than the random efforts of blind enthusiasm, so commonly exhibited by the African.

Therapeutic.—Organizational—mainly to see that personnel in wards and centres for these cases have sufficient vigour, knowledge, and understanding of the African, to be able to focus his attention on the requirements of the moment, and to dispel the clouds of doubt and distraction which so often inhibit action on his part.

Clinical—the avoidance of any passive or mechanical treatment, unless strongly indicated, for the African just delights in watching the "magic" machine doing the work, and once so habituated to ways so suited to his taste, strong and even harsh methods were needed to regain psychological "tone."

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Summary.

Considerable loss of trained man-power occurred among the native troops, of the East Africa Force, due to lesions in and around the knee-joint—particularly traumatic synovitis, osteo-arthritis, and partial tears of the collateral ligaments. Detailed analysis of over a thousand cases revealed that *Ætiology* was overwhelmingly traumatic, but that degeneration played a part: that other accessory influences (mainly anatomical, habitual, and psychological) were also at work: that the causative rôle of syphilis, and gonorrhœa was much less significant than usually supposed.

Pathology was noteworthy for the prominence of three elements as compared with the European: The formation of "internal" keloid; the frequent occurrence of nipping of the infrapatellar pad of fat, as a primary lesion; the incidence of marked psychosomatic reactions.

Treatment could be made to influence the morbidity further from two aspects—the prophylactic, by all means to avoid or minimize the various forms of reducible trauma cited above; and the therapeutic—by all measures to maintain and improve quadriceps muscle, volume, tone, co-ordination, and "awareness" particularly in the psychological and personality spheres.

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Clinical and Other Notes.

A CASE OF PNEUMOCOCCAL SEPTICÆMIA

BY

Lieutenant-Colonel JOHN MACKAY-DICK, M.B., Ch.B., F.R.C.P.Edin.

Royal Army Medical Corps.

THE patient, an officer aged 42 years, service five and three-quarter years, was admitted to 106 B.G.H. Antwerp on November 1, 1945.

He had felt well on October 28, 1945. On the morning of October 29 he felt very weak on waking and complained of severe frontal headache, pain behind the eyes, pains in his legs and a frequent irritable productive cough with a moderate amount of white frothy sputum. On October 30 he stayed in bed and did not report sick until the evening of the 31st when, in addition, he felt cold and shivery and sweated a little.

November 1: T. 102, P. 112, R. 30/40. The patient feels "done in." There is profound prostration, slight cyanosis, dyspnœa, with grunting respirations and continued irritating cough with greenish-yellow sputum. Throat feels raw. Liver and spleen not palpable. No rash. No lymphoglandular enlargement. B.P. 110/58. Both lungs show multitudes of fine and medium moist râles. No hæmoptysis.

He had no previous drug therapy for his illness.

Previous history.—No tropical service. Pneumonia and pleurisy with empyema aged 12 years. Frequent "bronchial" attacks in winter.

Immediately on admission blood was taken for a total and differential white blood cell count and *then* 4 grammes of sulphathiazole were given at once with alkalies and a routine course ordered. As soon as the results of the quickly performed white count were passed to me sulphathiazole was stopped which was just after the initial dose.

W.B.C. 1,600/c.mm. Polys. 51 per cent, monos. 1 per cent, lymphos. 48 per cent. This blood count was repeated immediately and verified. Blood was then taken for a blood culture and a pneumococcus was grown in time. This was later proved to be penicillin sensitive.

It was now felt that the patient was suffering either from a severe toxic illness normally characterized by a leucopenia or a profound prostrating illness due to an organism normally stimulating a polymorphonuclear leucocytosis but because of the profound toxæmia produced on this occasion it was characterized by a leucopenia: on these grounds and in the hope that the organism might be penicillin sensitive I prescribed a course of penicillin injections at once as follows:—

50,000 units I.M. stat. and 20,000 units I.M. three-hourly—also liver extract 4 c.c. I.M. daily and pentosenucleotide 40 c.c. I.M. in divided doses daily.

November 2: Afebrile by evening and very much better. W.B.C. 2,200/c.mm., polys. 62 per cent, monos. 9 per cent, lymphos. 29 per cent, platelets 125,000/c.mm. Bleeding time 1 minute. Clotting time 7 minutes. Sputum (Gram film): Predominating organism Gram-positive diplococci. Z.N. film: Gram-negative cocci. No T.B. seen.

Culture.—Pneumococci. *Micrococcus catarrhalis.* Yeasts present.

November 3: Signs in chest less marked but still present. A remarkable improvement in his general condition.

November 5: W.B.C. 14,000/c.mm., polys. 65 per cent, monos. 2 per cent, lymphos. 29 per cent.

November 6: W.B.C. 15,200/c.mm., polys. 58 per cent, monos. 12 per cent, lymphos. 30 per cent.

November 8: Seen by dental specialist. 8 teeth loose and should be extracted in due course. Otherwise teeth and gums healthy.

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November 10: Stop penicillin. Total 1,430,000 units.

November 13: X-ray chest: "Old rib resection 8th rib posteriorly. Considerable old pleural thickening and adhesions at left base pulling diaphragm upwards and heart to the left. In this left upper mid-zone there is a recent partial consolidation partially resolving."

November 19: X-ray chest: "No marked change in appearance of left lung. In addition it is now seen that there is a suspicious area of soft infiltration at the right apex. Pulmonary tuberculosis cannot be excluded. Suggest repeat in one week for progress."

Repeated sputum examinations negative for T.B.

November 24: X-ray chest: "No change from November 19."

Because of the radiological findings plus the scattered signs of activity at the left upper lobe he was evacuated to the U.K. for further observation, investigation and treatment. He made a complete recovery and returned to duty in U.K.

Commentary.—On the fourth day of a severe prostrating febrile illness a blood culture revealed pneumococci in pure culture. I realize that pneumococci may be isolated from the blood early on in cases of pneumonia with bad prognosis especially in old people. However, on the fourth day of his illness the whole extent of each lung showed multitudes of fine and medium crepitations on auscultation. There was no evidence of consolidation in the lungs, and no hæmoptysis at that time. Associated with all this was a pronounced neutropenia in the peripheral blood. Pneumonic consolidation did occur and persisted as the radiological reports show. The clinical picture was that of a septicæmia and the organism isolated from the blood was penicillin sensitive.

N.B.—On admission the W.B.C. was repeated several times and the presence of profound neutropenia confirmed. There was a dramatic response to penicillin therapy and the subsequent white blood cell counts are of interest.

This case emphasizes: The importance of an immediate total and differential white blood cell count in febrile cases of vague origin. That a septicæmia due to a pyogenic organism which usually provokes a neutrophil leucocytosis may be accompanied by little or no change in the white blood cell count and on occasion is actually accompanied by a neutropenia of varying degree. The importance of an immediate blood culture in a case such as this. The value of the prompt exhibition of penicillin as a prophylaxis against secondary invaders and on the odd chance that the main infecting agent might be penicillin sensitive as it was in this case. The rapid investigation and prompt exhibition of penicillin was life-saving in this case.

Acknowledgments are made to: Major-General Sir Edward Phillips, *K.B.E., C.B., D.S.O., M.C.*, D.M.S. British Army of the Rhine, for permission to forward these notes. Major M. J. Pivawer, R.A.M.C. Pathologist; Major R. L. Mansi, R.A.M.C. Radiologist, Major W. E. Duckworth, R.A.D.Corps and Capt. B. S. B. Wood, R.A.M.C., for their help with this case.

A CASE OF SEPTICÆMIA (HÆMOLYTIC *STAPHYLOCOCCUS AUREUS*) CONFUSED WITH CLINICAL HEPATIC AMŒBIASIS

BY

Lieutenant-Colonel **JOHN MACKAY-DICK, M.B., Ch.B., F.R.C.P.Edin.**
Royal Army Medical Corps.

THE patient, an officer aged 35, service five years, was admitted to No. 13 General Hospital on September 24, 1944.

On his right buttock was a partially healed furuncle which had been present for one month.

Three days before admission to hospital he complained of a febrile illness with cold shivers and generalized aches and pains.

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On examination (September 24).—T. 99·8, P. 88. Nil else of note beyond partially healed furuncle on right buttock.

Blood films and thick drops were examined repeatedly but no evidence of malarial parasites was found. W.B.C. 6,400/c.mm., polys. 58 per cent. W.B.C. 5,400/c.mm. (September 30). W.B.C. 10,000/c.mm., N. 78 per cent, L. 15 per cent, M. 5 per cent, E. 1 per cent, B. 1 per cent (October 4). W.B.C. 13,700/c.mm., N. 77 per cent, L. 16 per cent, M. 6 per cent, E. 1 per cent (October 9).

[Note: Climbing white blood cell count.]

Urine: Midstream. Culture: *Staph. albus* isolated from fourth culture on October 10 after three negatives.

Stools (6): Culture: Nil pathogenic isolated. Sigmoidoscopic examination revealed nil of note.

Screen Diaphragm (October 4): "Lung fields and mediastinum normal in appearance. Right diaphragm elevated, flattened, movement restricted, obliteration of costophrenic angle suggesting adhesion. Liver pathology as origin cannot be excluded.

Blood culture sterile (October 2).

Blood Culture: Hæmolytic *Staphylococcus aureus* (October 10).

Urine: Microscopic. N.A.D.

Low-grade irregular pyrexia continued, the patient had marked sweats in the early mornings with severe pains in his shins and joints. Stools showed no *E. histolytica,* etc. In view of radiological findings and rising white blood cell count a course of emetine H.Cl. as for hepatic amœbiasis, was commenced on October 6.

However, the clinical picture was very strongly suspicious of a septicæmia. There was the unhealed boil, the febrile illness, the sweats and joint pains together with a rising white blood cell count and finally the positive blood culture. The latter was repeated but this culture was sterile.

The following course of penicillin was commenced on October 15 at 1900 hours:—

Initial dose—25,000 units I.M. At three-hourly intervals 15,000 units I.M. for four days. Then at four-hourly intervals 15,000 units I.M. for three days.

W.B.C. 11,500/c.mm. N. 72 per cent, L. 24 per cent, M. 2 per cent, E. 2 per cent (October 16).

W.B.C. 9,000/c.mm. N. 74 per cent, L. 18 per cent, M. 2 per cent, E. 3 per cent, B. 3 per cent (October 22).

He lost one stone in weight during his present illness.

A case such as this, especially in view of the radiological findings, might be confused with clinical hepatic amœbiasis, as indeed it was, and as such cases quite understandably are known to be because of the liver being a not uncommon site of localization in staphylococcal septicæmias. Another never-to-be-forgotten site of localization in staphylococcal septicæmias is bone; two cases of osteomyelitis of a transverse process leap readily to mind.

Another point which I feel should be emphasized in cases of pyrexia of doubtful origin is a repetition of investigations including oft-repeated total and differential white blood cell counts as for a varying length of time a white cell count below 10,000/c.mm. is a frequent finding in staphylococcal septicæmia.

Acknowledgment.—Major-General Sir Edward Phillips, *K.B.E., C.B., D.S.O., M.C.*, D.M.S. British Army of the Rhine, for permission to forward these case notes.

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Review.

SYNOPSIS OF HYGIENE. Ninth Edition. By Jameson and Parkinson. J. & A. Churchill Ltd. Price 28s.

It is a pleasure to greet the new edition of the Synopsis of Hygiene (Jameson and Parkinson). The ninth edition by Brigadier Parkinson assisted by Miss Kathleen Shaw lives up to the reputation of its predecessors as an invaluable vade-mecum for the hygiene officer and an excellent manual of reference for all officers of the R.A.M.C. The size of the book has had to be enlarged to include the complexities of civil health administration due to the present change in outlook and the rising tide of social legislation. The necessity to be up to date in this field and hence to give a detailed picture of laws now in force and those shortly to be enforced has led perhaps to a sacrifice of unity of purpose and clearness in some of the sections, while the little attention paid for example to the use of mepacrine and paludrine in the suppressive treatment of malaria and the advocacy of quinine in this respect may tend to blind the minds of the R.A.M.C. to the excellence of the book. It gives us, then, a reasonable picture of the newly planned health services in this country, statements of the scope and responsibilities of those services and a very fine synopsis of the science of hygiene, which should be available for the use of every hygiene officer.

J. J. O'D.

Notices.

CURARE FILM

A FILM on *d*-tubocurarine chloride, prepared by the Wellcome Film Unit, received its first showing at The Wellcome Research Institution on February 19. In colour, the film demonstrates very clearly the effect of the drug both experimentally and in surgical practice. It is now available for exhibition to practitioners and students. Application for copies should be made to The Wellcome Film Unit, The Wellcome Research Institution, 183-193, Euston Road, London, N.W.1.

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ARTISTS IN THE FORCES

The Army Art Society, which held its most successful exhibition last year, when entries were accepted for the first time from artists of all ranks in the three Services, is organizing another display to be held next October at the Imperial Institute, South Kensington. This will be the seventeenth since the foundation of the movement twenty-three years ago—at first known as the Army Officers' Art Society—and an effort is to be made to make the annual event, interrupted only by the war, even more successful.

A feature of the last exhibition was the quality of artistic achievement it showed among Service men, past and present, particularly in water colours, black and white drawings, chalk and pencil. Oil paintings and sculpture were fewer in number, but of good standard. Subjects were mainly landscape and figure, but they presented, as Service art exhibits always do, a wider variety of scenes and races than civilian displays. British soldiers, sailors and airmen of all ranks, by the exigencies of their service overseas, often in remote and normally inaccessible regions, and in contact with so many races and tribes, have a wider choice of subjects than is possible to the civilian artists, or even the film producers.

480 Works were sent in last year, and of these 430 were shown, many of them arousing very appreciative comment. It is hoped to attract an even larger number of works for the next display, being convinced that there are still many men of artistic achievement, past or still serving, who can usefully contribute to the progressive improvement that the society seeks to attain. A good knowledge of painting and drawing is fine training of the powers of observation and may come to be recognized in future as a useful addition to the qualifications of a Service man seeking advancement in his career.

The Honorary Secretary, Col. L. N. Malan, *O.B.E.*, 2 Iverna Gardens, Kensington, W.8, will be glad to send further particulars on application.

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References : Shortage of space precludes list of references, but full documentation may be obtained on application to Clinical Research Dept. 35.E.

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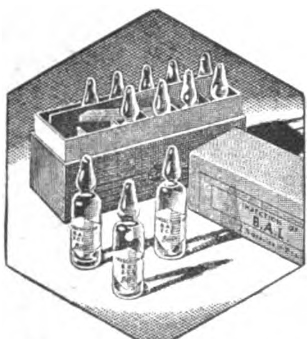

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Journal
of the
Royal Army Medical Corps.

Editorial.

INDIA.

THIS year of Grace, 1948, finds the Royal Army Medical Corps celebrating its Jubilee. With the departure of the British Army from India it also finds us facing a complete reorientation as to our foreign service.

In an Indian Army List of early 1939, there appear the names of some 270 officers of the Royal Army Medical Corps serving on the Indian Establishment. In 1948 there are none.

Before the recent war it was exceptional to meet a senior officer who had not served in India, while an officer who came to India for the first time as a Major-General was, indeed, a *rara avis*. It may be accepted that the majority of our officers served at least one tour in India. Many spent the greater part of their overseas service in that country.

A great deal of very valuable professional and research work was done, in spite of climatic and other difficulties. Various frontier troubles afforded invaluable training for events then hidden in the womb of the future.

On the whole, in spite of many drawbacks, life was pleasant—at least in retrospect. There were trying and unpleasant things to contend with—mosquitoes, snakes, the brain-fever bird—the hot weather of the Punjab plains and the U.P.—the isolation of some of the smaller stations such as Multan, Nasirabad or Kamptee (for all of which, incidentally, there was much to be said)—but, on the whole, life was good. It was a man's country. It may well be that cantonment life tended to isolate us too much from the Indians and Indian thought; but some of us were able to meet educated Indians and make friends of them.

There were many recreations and healthy sports. Qualities of character engendered in at least one officer addicted to the pursuit of tiger in his leisure hours eventually led him to high places in the recent war.

Well, the kaleidoscope of life as we knew it in India is gone. The change is as complete as attended the departure of the Roman Legions from Britain. Never again shall we know the sleepless nights of the hot weather in the Plains —nor yet the cool, clear, pine-scented days in the Hills with the welcome

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evening fires. Nor shall we see the bursting forth of new life that followed the onset of the monsoon. An Irish orderly once said, "It's a wonderful thing to see all these barren hills turn green when the rains come. Sure, Sir, 'tis very restful to the eye." There was a certain corner on the Murree Road where one always seemed to meet a cool mountain breeze scented by the pines.

Gone is also the artificial—and it was artificial—social life of the large cantonment with its clubs, dances, dinner parties and the like.

There were, however, more healthy activities in which our officers played no mean part. We had at least one master of the Peshawar Vale Hunt and one of the Mhow Hunt. We have played golf and fished in Kashmir and performed creditably with the Gulmarg Ski Club. One of our more optimistic officers created a record by arriving in Mallapuram with his skis!

We took an active interest in everything—racing, where our officers (or at least their horses) succeeded more than somewhat—sailing—amateur dramatics and, in short, in every form of social and sporting activity.

All this infinite variety of life in India did not detract from the fact that professional work came before all else. It was conscientiously done and reached a high standard. A great deal of original research work was done particularly into the dysenteries, malaria and the effects of heat. In malaria research we were privileged to work in the closest harmony with our colleagues of the I.M.S. A great deal of sound experience in surgery and general medicine was accumulated. All this was of incalculable value in the recent war. It is true that much, perhaps equally valuable, work was done elsewhere, but the greater part of our knowledge of tropical disease and of tropical hygiene came from Indian experience. There are, to be sure, many tropical diseases from which providence has seen fit to exclude India, but there were quite enough to go on with. With malaria, plague, smallpox, typhus, dengue, kala-azar, dysenteries and others, endemic, our officers had adequate experience in their treatment and control. We were able to study the protean manifestations of the effects of heat. It is to be hoped that all this will be recorded in such a form as to be easily accessible to the rising generations.

Our present knowledge of the effects of cysticercosis in man came from its occurrence in patients who had served in India.

One has only to walk through the museum of the Hygiene Department of the Royal Army Medical College to appreciate how much of the work of our hygiene experts has been influenced by their Indian experience.

Now we have come to the close of an era. This calls for a complete reorganization of our training in tropical medicine and hygiene—a call which one is confident will be responded to as efficiently as all calls on us in the past.

There are many to whom at this time we would pay tribute.

First there are the Nursing Sisters and orderlies, both Regimental and R.A.M.C., to whose devoted work under such varied conditions our patients owe so much.

There are the officers of the Indian Medical Service both British and Indian.

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with whom we worked in such close harmony both in peace and war, and whose sage advice and professional help was often invaluable and always gladly given.

We owed a great deal to the Assistant Surgeons who did so much routine, technical and professional work both competently and cheerfully, and who relieved us of so much routine minutiæ.

We do not forget the humble members of the I.H.C. who did so much as clerks, wardboys and menials to make our hospitals as efficient as they were.

There are many of us who owed a great deal to some of our Indian professional colleagues, particularly in the cities. Some of them were men of high culture and attainments who were always willing to give professional advice.

Lastly, but by no means least, there were our humble servants—bearers, butlers, cooks, khitmagars, bhistis, dhobis, durzis, malis, sweepers who, as a class, were faithful and loyal to their sahibs and memsahibs. They did a great deal to make our lives comfortable and at times we miss them sadly.

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Original Communications.

EFFECTS OF HEAT WITH SPECIAL REFERENCE TO ITS OCCURRENCE IN BRITISH TROOPS IN THE PERSIAN GULF AREA IN 1941–42.

BY

Lieutenant-Colonel W. STEWART,

Royal Army Medical Corps.

[*Received November* 19, 1947.]

THE effects of heat are encountered in the hot countries of the East and to a lesser extent in various industries in this country. The writer observed them amongst British troops in the Persian Gulf Area in 1941 and 1942. In the summer of 1942, amongst British troops, there were 168 cases of heat stroke (1·19 per cent of the strength) with 32 deaths (case mortality rate 19·05 per cent) and 1,955 cases of heat exhaustion, i.e. 13·7 per cent of the strength with 13 deaths (case mortality rate 0·66 per cent). In addition to these casualties there was loss of efficiency both mental and physical which was not assessable but must have been great.

Sir Sheldon Dudley (1946) states that the lack of efficiency due to anoxæmia in aircrews operating at high altitudes in the early days of the R.A.F. was insidious and not appreciated by aircrews and that naval personnel scoffed at the idea that their mental and physical capacity was significantly impaired by the excessive warmth of their environment. It has long been appreciated that high temperature and high humidity cause a decrease in capacity for physical work and we all have experienced disinclination for mental work in hot weather. Mackworth (1946) clearly demonstrated the effect of hot humid environment on actual mental capacity by a prolonged experiment on trained wireless operators in the Eastern Fleet. He showed that considerable impairment in accuracy appeared with an effective temperature of 87·5° F. He also showed that exceptionally good men were least affected and men of ordinary or less ability were most affected.

Weiner and Hutchinson (1945) found that motor co-ordination was considerably impaired by hot humid environment, i.e. an effective temperature above 90° F. They used a special co-ordination test consisting of metal balls on moving tables. The balls had to be picked up from one place on the moving table and placed on another part of the table. Time taken and errors made were considered in reaching a conclusion.

Caplan and Lindsay (1946) observed the effects of heat on the physical capacity of Indians working in the Kolar Gold Fields. The test consisted of hand-drilling granite and it lasted three hours. The number of inches drilled

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was measured. They reckoned the first hour of work in a temperate of 83° F. wet bulb as 100 per cent efficiency and found that efficiency fell to 80 per cent at wet bulb temperature of 85° F. and to 50 per cent at wet bulb temperature of 94·4° F. They considered that no useful work could be done after the first hour at temperature of 93° F. wet bulb or over.

In industry in this country it has been observed that in addition to causing discomfort and affecting working capacity the accident rate is increased where temperatures are high, especially amongst older workers; probably due to the more rapid fatigue amongst older men as the temperature rises.

The importance of environmental warmth in factories is recognized by the inclusion in the Factory Act 1937 of Schedule I laying down the temperatures and humidities which are permissible.

Much work remains to be done on the above problem of loss of efficiency though much has already been done. The importance of the problem can readily be appreciated.

In this paper it is intended to deal particularly with the more obvious types of effects of heat as seen in British troops in the Persian Gulf Area.

Effects of heat due to climatic causes are, general constitutional effects and sunburn. Sunburn will not be further considered as it is purely a reaction of the skin due to ultraviolet light and is easily preventable and treated as any other burn.

Ætiology of General Effects of Heat.—The essential cause is exposure to high atmospheric temperature. It is considered that the sun's rays have no special actinic action. Aron in Manila exposed monkeys to a hot sun, their bodies being protected in well-ventilated boxes but their shaven heads exposed to the sun, and found no harm occurred although the scalp temperature rose as high as 47° C. (116·6° F.). Body heat is lost by conduction, convection, radiation and evaporation. In an atmosphere above body temperature all but evaporation cease; the first three may in fact be reversed. The efficiency of evaporation depends on relative humidity and on air movement. Adolph, E. F. (1947), says that air movement over 400 feet per minute has little additional cooling effect. Ladell (1947) has shown that increase of air movement from 75 to 200 feet per minute increases wet bulb tolerance by only 1° F., but at lesser velocity air movement is important, as the original experiments of Leonard Hill showed.

As far as temperature is concerned it is considered that a wet bulb temperature of 83° F. is the danger point.

Air movement, within limits, aids evaporation by replacing the layer of air adjacent to the body as it becomes saturated. In contradistinction to Adolph's opinion about the effects of velocity it is considered that very hot strong winds, e.g. 40 m.p.h. at 122° F. dry bulb on an unprotected body, are dangerous as the rate of application of heat may exceed the rate of loss of heat by evaporation. Such dangerous winds may be encountered in the deserts of Iraq and Southern Persia and drivers of vehicles sometimes accentuated this effect by stripping to the waist and opening windscreens to their fullest extent.

In summer in Persia and Iraq relative humidity is very low and the wet

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bulb rarely exceeds 75° F. Casualties from effects of heat began when dry bulb reached 110° F. and were numerous when it exceeded 120° F.

The method of measuring environmental conditions is not standard throughout. The Americans use the effective temperature scale which takes into consideration temperature, air movement, and relative humidity. T. Bedford in this country has adopted this scale.

Adolph considers the effective temperature scale is useful, provided radiant heat has not to be considered and thinks it is not so good as wet bulb at high temperatures. Lindsay, J. K. (1946), believes wet bulb to be as useful if not better than effective temperature at temperatures near the limit of endurance.

The corrected effective temperature scale which takes into account temperature, humidity, air movement *and* radiant heat has been adopted provisionally as the index of warmth to be used in connexion with measurements made in H.M. Ships. (M.R.C. War Memorandum No. 17.)

More work to determine the best standard to use is required and also to determine the effects of solar radiation (and machine and furnace radiation) (Adolph, E. F.). This is particularly necessary because it would appear that at effective temperatures above 90° F. effective temperature makes too much allowance for dry bulb temperature while wet bulb temperature has more bearing on bodily reactions.

PREDISPOSING FACTORS.

Exogenous.—High humidity, still air, hot winds, unsuitable clothing, deficient fluid intake, deficient salt intake, lack of rest and sleep, strenuous physical exertion.

Endogenous.—Non-acclimatization, dehydration due to excessive sweating, poor physical condition caused by fatigue or morbid processes, e.g. alcoholism, seasickness, hyperthyroidism, and defective sweating due to chronic skin trouble, congenital or acquired anhydrosis, or effects of atropine. Illness associated with high fever is especially dangerous.

In the case of troops arriving in the Persian Gulf Area in hot weather, seasickness, monsoon conditions and the discomforts and fatigue of disembarkation were important. In 60 per cent of 199 cases, circumstances preceding the attack were recorded as "On Board Ship."

PATHOLOGY.

Much of the pathology is that of dehydration, Nadal (1942) describes two types of dehydration.

Simple: due to inadequate water intake. There is no abnormal loss of salt so that extracellular, intracellular and plasma balance of water is not disturbed. Manifestations of this type are thirst, oliguria, concentrated urine, rising blood urea. The condition is relieved by adequate intake of water.

Extracellular dehydration: due to excessive loss of fluid by sweating, diarrhœa or vomiting. Fluid lost by these means contains extracellular electrolytes—chiefly sodium and chloride. Loss of sodium leads to diminution of extracellular fluid volume, including plasma volume, even though

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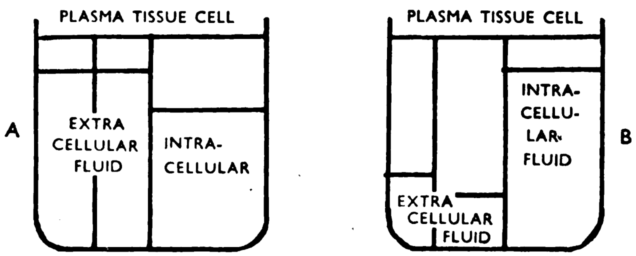
water intake is normal. Manifestations of this type are weakness, apathy, anoxia, nausea, low B.P., hæmoconcentration, and often hypochloræmia. Anuria and rising blood urea occur when blood pressure is low. Thirst is *not* present. Sodium chloride as well as water is necessary to relieve the condition.

Both types of dehydration are commonly present together.

H. L. Marriott (1946) has recommended the adoption of the term "water depletion" and "salt depletion" for the above types, and he considers that in simple water depletion the extracellular fluid becomes hypertonic because water is lost from it through the lungs, skin and urine without fully parallel salt loss. In consequence water is sucked out of the cells and the volume of the extracellular fluids tends to be maintained.



A. Osmotic pressure in pure water depletion.
B. Osmotic pressure in pure salt depletion.

Under normal conditions water intake exceeds requirements and balance is maintained by renal excretion of the surplus. Average adult intake and output figures are given as:—

Intake	***ml.***	***Output***	***ml.***
As fluid	1,500	Vaporization ...	1,000
As solid food ...	1,100	[Lungs, 400; Skin, 600]	
		Urine	1,500
		Fæces	100
Total	2,600	Total	2,600

If all water intake stops unavoidable water loss continues (1) by vaporization 1,000 ml., (2) by urine 500 ml.

Thus the body loses water at the rate of 2 per cent of body-weight per day. Death occurs when the loss reaches approximately 15 per cent of body-weight or 20-22 per cent of body water, i.e. in seven to ten days.

Blood Changes.

Blood chlorides are reduced. Marsh in Abadan found a mean of 494 mg. per 100 ml. in 50 men in cool weather: of 466 mg. per 100 ml. per 50 men in hot weather and 448 per 100 c.c. in 15 men suffering from effects of heat.

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Plasma bicarbonate reduction also occurs.

Blood lactic acid may be increased; in one case of heat stroke it rose to 100 mg. per 100 ml. and higher readings have been observed in dogs and rabbits.

Dehydration is associated with hæmo-concentration as shown by increased R.B.C. count and increased Hb. percentage. Ladell *et al.* (1944) found plasma volume reductions up to 50 per cent in heat exhaustion. Leonard Rogers demonstrated many years ago how in severe cholera as much as two-thirds of plasma volume may be lost. Plasma volume may be measured directly but may be deduced from hæmoglobin percentage, hæmatocrit and plasma and whole blood specific gravities. The last named is probably of most use and can be determined by the falling drop method, using graduated mixtures of glycerine and water (Rogers) or graduated copper sulphate dilutions (Van Slyke, 1943). The latter has been used extensively in the Army. If hæmoglobin is also determined plasma volume can be estimated by calculation.

Blood urea is sometimes considerably raised. Ladell *et al.* (1944) found it raised in all cases of salt-depletion heat exhaustion.

Hyperglycæmia has been recorded.

Urine.

Urine chloride is frequently low or absent and was found to be so in 74 per cent of 769 cases. There appears to be little correlation between hypochloruria and the duration of exposure to heat or severity of the symptoms. Serious hypochloruria is a danger signal and the fact that when plasma sodium and chloride tend to fall the kidneys excrete water and sacrifice plasma volume to preserve electrolyte concentration, makes the urine chloride content a most useful guide. The test described by Fantus (1936) is a simple and effective method of estimating urine chloride.

The requirements are a small test tube, a small pipette (fountain pen filler), 20 per cent potassium chromate solution, 2·9 per cent silver nitrate solution and some distilled water for rinsing the pipette. Ten drops of urine are measured into the test tube. The pipette is rinsed and one drop of potassium chromate—the indicator—is added. The pipette is rinsed again and then the silver nitrate solution is added a drop at a time and the test tube shaken after the addition of each drop. The number of drops needed to produce the end point gives the concentration of chloride in the urine expressed as grammes of NaCl per litre for example 5 drops = 5 grammes of NaCl per litre. It is important to make a preliminary test with distilled water to make sure that there is no contamination of the chromate solution with chloride. If the urine contains 5 grammes per litre or more the patient is unlikely to be suffering from salt depletion.

This simple test is most useful as a diagnostic measure, as a guide to treatment and also it can be useful in M.I. Room work to separate salt depletion heat exhaustion from psychoneurotic collapse and ill-health due to other causes.

This test is also of value in temperate climates in any conditions where fluid tends to be lost from, or retained in, the body.

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Morbid Anatomy.

The temperature of the body is high but this is not diagnostic of heat hyperpyrexia. Rigor mortis is immediate and the heart hard and firmly contracted. Organs are congested especially the lungs and brain. Minute hæmorrhages occur in the skin, subcutaneous tissues, internal organs and brain. Occasionally there is intense congestion of the mucous membrane of the stomach and small intestine, resembling hæmorrhagic gastritis. Pressure cone of the cerebellum was seen in two congestive cases. Terminal bronchopneumonia occurs.

Microscopically the most striking feature is venous engorgement of all organs and tissues with multiple hæmorrhages through the tissue walls. The brain is œdematous in all cases, permeability of its vessel walls is increased and punctate hæmorrhages are present. There is hæmorrhagic œdema of the lungs reducing the capacity of the alveoli. Degeneration and early necrotic changes are found in the parenchymatous cells of organs but these may be an expression of rapid degeneration and autolysis after death.

Symptomatology and Clinical Observation.

Ladell, Waterlow, and Hudson (1944) reported observations in 1943 on fit soldiers and cases of effects of heat. All fit men lost some weight. The highest loss was in men with highest chloride concentration in their sweat—maybe due to slight salt-deficiency dehydration. Evidence of salt-deficiency dehydration was the low urine output with high water intake and low urine chloride (less than 2 grammes a day). Blood urea was raised. They reported 12 cases of heat hyperpyrexia all of whom went through a phase of negative H_2O balance; that is to say they had polyuria with little intake of water. Waterlow (1947) also described two types of heat exhaustion, one at the peak of high temperatures in people with high sweat salt and the other towards the end of the summer in men who had withstood the heat of the summer and began to get prickly heat, etc.

Headquarters Persia and Iraq Force described effects of heat in groups, viz. (1) Heat Exhaustion; (2) Subacute Effects of Heat; (3) Acute Heat Stroke; (4) Heat Cramps.

The essential cause is HEAT (as a physical agent). The effect depends on previous condition and on the severity and duration of exposure. Although the clinical manifestations are divided into four groups, it is one condition and the different types may be mixed.

Heat Exhaustion.

The outstanding feature is circulatory asthenia. Chief complaints are weakness, headache, nausea, and giddiness. In more severe cases fainting occurs. The skin is pale and clammy and the pulse weak and rapid. Blood pressure is low and the pupils dilated. Temperature is often normal or subnormal. Urine chlorides are usually reduced and heat cramps are often found in association with this condition.

The attack in itself is not usually serious but severe or fatal collapse may supervene.

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Subacute Effects of Heat.

Onset is insidious and the symptoms could be due to a variety of causes. There is a nearly apyrexial stage with increasing derangement of body chemistry and a final phase with high fever. This final phase is more refractory to treatment than acute heat stroke, in a previously healthy individual. Most of the signs and symptoms are due to extracellular dehydration (salt depletion).

In the apyrexial stage there is lassitude, headache, anorexia, nausea, vomiting, and abdominal pain. Mental symptoms occur—dullness, irritability, restlessness, disrespect, insubordination, or other departures from the patient's normal behaviour. Also there may be sleeplessness, frequency of micturition, constipation, diarrhœa, giddiness, pain behind knees, muscular cramps and twitchings. The skin may be moist or dry. Unless such a patient is kept in a cool place his condition will deteriorate and signs of advanced dehydration will appear—namely inelastic skin, sunken eyes and oliguria. Temperature begins to rise, the blood becomes concentrated, and mild leucocytosis and rise in blood urea occur.

The pyrexial stage is often ushered in by increased mental symptoms which may be maniacal. The temperature rises to 105–112° F. Consciousness is at first clouded and coma supervenes. The skin is hot, dry, gritty, and inelastic: the face sunken; general muscular rigidity supervenes; convulsions are common and localized pareses are sometimes seen. Blood and urine changes become more marked. The temperature can be reduced by heat-stroke treatment but the majority die in from one to four days. Circulatory failure and bronchopneumonia are the usual terminal events.

Acute Heat Stroke.

This form is due to sudden failure of the mechanism of body temperature control. There may be mild prodromal symptoms of the nature of those at the onset of the subacute type, and suppression of sweating for a day or two. Frequently it attacks individuals in apparently good health and so suddenly that they are found unconscious.

The chief features are high fever with circulatory failure in later stages. Usually there is delirium, coma and stupor. The temperature rises to between 105 and 109 or even 112° F. The face is congested, eyes suffused, pulse full and bounding; the skin is hot and dry and the pupils contracted; respiration is stertorous. Vomiting is not unusual. Muscular rigidity, cerebral irritation and convulsions occur. There may be localized pareses and knee and ankle jerks may be depressed or abolished. Plantar reflexes may be extensor. Cerebrospinal fluid examination does not show any typical changes. Urine chlorides may or may not be reduced. After a short time circulatory failure supervenes and is the usual cause of death.

Heat Cramps.

Occur either alone or with other manifestations of the effects of heat. They are seen most typically in men performing heavy physical work in a

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high temperature and do not appear to be related to relative humidity. Stokers on ships are notoriously liable to this condition. Deficiency of sodium chloride in the body fluids due to excessive sweating is generally held to be the important causative factor.

Cramps are usually symmetrically distributed and the muscles specially involved are those most used in the work being done. Hæmoconcentration may be present.

Diagnosis.

Subacute Effects of Heat.—Great difficulty in diagnosis may be experienced. Gastritis, peptic ulcer, pre-icteric stage of infective hepatitis, intestinal obstruction or renal tract disease, may all be simulated. Mental symptoms may result in disciplinary action. Meningitis, malaria, chronic dysentery, uræmia may also be mistaken. The danger lies in overlooking the fact that the trouble is due to effects of heat and the case may slip into the intractable form of hyperpyrexia. Marriott (1947) lays great stress on the value of testing the urine for chlorides and quotes White who applied the test at the Air Headquarters, Delhi, in 1943 and diagnosed 29 patients out of 140 with various indefinite complaints.

Rectal temperature recording is also valuable.

Heat Exhaustion.—The same remarks as above apply to *heat exhaustion* and it is necessary to exclude algid malaria, acute alcoholism, hypoglycæmia, epilepsy, and sea-sickness.

Heat Cramps.—Intestinal colic must be differentiated from abdominal cramps. In true cramps the muscles affected become palpably hard and conversation is interrupted.

Acute Heat Stroke.—In acute heat stroke the circumstances usually give a lead and the condition requires immediate cooling treatment. Other causes, e.g. cerebral malaria, must be considered, and in all cases a thick and thin blood film must be examined. Cerebrospinal fever, pneumonia, sand-fly fever, typhoid fever, typhus fever, smallpox and cerebral hæmorrhage must be thought of.

Prognosis.

Prompt and efficient treatment is all-important. Adverse factors are obesity, advanced age, and the presence of other diseases such as renal disease, acute or chronic alcoholism, or pulmonary tuberculosis. In cases of hyperpyrexia the height of the fever and the duration before control is established is important.

Recovery from 108° F. can be expected.
Recovery from 109° F. can be expected if not over one and half hours.
Recovery from 112° F. has been seen with very prompt treatment.

Treatment.

Prevention is the prime essential. The problem of prevention will be discussed later in the paper.

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Immediate treatment in the earliest stage is essential—this makes early diagnosis of great importance.

Hyperpyrexia or effects of heat must be treated first and at once, but search must be carried on for other possible causes.

The principles of treatment are to provide a cool atmosphere, rest, reduce body temperature and to replace fluids and salt loss.

In mild cases give copious 0·25 per cent sodium chloride drinks in a cool atmosphere, 80° F. dry bulb is best. Above 80° F. the air must be kept moving by fan or punkah. Fluid requirements may be up to 20 pints in twenty-four hours until urine of normal sodium chloride content is being freely excreted.

Give also iced sweetened condensed milk if this can be taken. If constipation is present this must be attended to.

Cases of exhaustion with subnormal temperature may require hot bottles, blankets and circulatory stimulants.

In cases of heat cramps salt solution may be given in large quantities. A cool atmosphere is essential in all cases.

In every case the administration of fluids must be based on a careful assessment of the amount of water depletion and salt depletion. Haphazard administration of fluids is potentially highly dangerous and is also apt to be ineffective. Assessment should be based on the degree of dehydration as shown by: (a) Blood concentration as judged by R.B.C. and Hb. estimation. (b) Amount of urinary secretion. (c) Chloride content of the urine. (d) Blood pressure.

Marriott recommends the measurement of plasma volume by correlating the blood gravity as estimated by Rogers or Van Slyke methods and the hæmoglobin and hæmatocrit percentages.

Replacement of fluid must be the subject of careful observation and careful check must be kept. A fluid balance sheet as below should be used.

FLUID BALANCE SHEET.

Name.............................. 24 hours ending.

INTAKE		OUTPUT
INTRAVENOUSLY		
†......% at ...... drops per min. =	Pints	Urine A.M. ...... Pints
‡......% at ...... drops per min. =	Pints	P.M. ...... Pints
......% at ...... drops per min. =	Pints	Vomit
BY MOUTH		Fæces.
		§Sweating.
Total =		Total =
*Glucose ...... calories.		

*Glucose—5% Glucose sol. allow 30 grammes = 120 calories per pint.

†50 drops per minute = 6 pints in twenty-four hours.

‡30 drops per minute = 3 3/5 pints in twenty-four hours.

§Very variable—allow not less than 8 pints at rest in cool room in hot weather.

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Route of Administration of Fluids.

Rectal and subcutaneous administration are rarely satisfactory.

Oral.—is good in less severe cases. Give when dehydration is not marked, when there is no definite hæmoconcentration, where vomiting is only occasional, and when the systolic B.P. is above 100 mm.Hg. Sodium chloride 0·25 per cent solution is usually given but if urine chloride is very low start with isotonic saline (0·9 per cent sodium chloride) and if there is evidence of acidosis add 0.1 per cent sodium bicarbonate.

Intravenous.—Administration is essential where there is marked dehydration and hæmoconcentration, low blood pressure, and/or persistent vomiting. Great care must be taken to avoid overloading the circulatory system and drowning the patient. This entails measuring input and output of fluid and salt.

Fluids for intravenous administration must be pyrogen free. Normal saline, isotonic glucose saline (2·5 grammes glucose + 0·425 gramme sodium chloride to 100 c.c.) or 5 per cent glucose in water may be used. These can be given fast at the beginning. Stop I.V. administration if cardiovascular system cannot cope with it as indicated by low B.P. or signs of pulmonary œdema, or if the fluid and salt deficiencies are made up as measured by the relief of hæmoconcentration and free secretion of urine with normal chloride content.

Specific Treatment of a Case of Heat Hyperpyrexia.

Place the patient naked on a charpoy (Indian type of string bed). Apply cold water and keep the air moving by means of a fan. Sponging or covering with a wet sheet is satisfactory.

It has been established that the evaporation of water at body temperature carries away 0·59 calories per gramme of water used. Melting ice only takes away 0·08 calories per gramme, in addition the application of ice tends to damage the skin.

Seventy grammes of water evaporated from the skin remove as much heat as 1,000 grammes of water used as an iced enema.

If the atmosphere is saturated with moisture the patient should be immersed in a cold bath.

These methods are drastic and the rectal temperature must be carefully watched and cooling treatment stopped when the temperature is reduced, e.g. from 109° to 106° or from 106° to 102° F.

Venesection is good for venous congestion.

Pentothal or chloroform is useful for convulsions; give just enough to control the convulsions. Marsh at Abadan recommends continuous administration of oxygen to relieve venous congestion and convulsions.

Lumbar puncture is disappointing—the C.S.F. pressure is usually low and if it is high there is a danger of a pressure cone.

If respiratory failure threatens, caffeine, coramine, and artificial respiration should be used.

If malaria is suspected do not hesitate to give quinine grains 8–10 intra-

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venously. If intravenous fluid is being given it can be given through the tube already inserted in the vein. This is useful as it is sometimes difficult to get into a vein. The quinine can be repeated in six hours if necessary. The search for the malaria parasite should be persistent.

After-treatment.

Severe cases should be treated as for concussion and in fact they are liable to have sequelæ similar to the sequelæ of severe head injuries, such as changed personality and behaviour, intolerance of alcohol, and in addition they are very susceptible to effects of heat if exposed again.

Convalescence should be in a cool climate if possible and the patient should be moved permanently to a cooler climate.

In Persia this moving of patients offered difficulties as some got hyperpyrexia travelling to an adjacent aerodrome for evacuation and one patient who had complete absence of sweat glands from the skin, could not make the journey and remained in hospital until cooler weather made his evacuation possible.

Prevention.

Personnel Selection.—Medical examination of all individuals likely to be exposed to high temperatures should be done to exclude all liable to suffer excessively. Age appears to be an important factor. Adolph (1947) found young men of 21-26 years more tolerant and in Army experience men over 40 were definitely more liable to suffer. Individuals with relatively small surface area to their bulk fare badly as do chronic alcoholics, chronic bronchitics and men with renal tract lesions. Congenital absence of sweat glands is occasionally met with. One such case was seen in Iraq (he was a R.A.F. Other Rank) and had to stay in hospital all through the hot weather. Macquaide (1944) describes two cases of "hereditary ectodermal dysplasia of anidrotic type" which consists of congenital absence of sweat glands with other easily recognizable features.

Regular periodical medical examination of personnel in the hot area should be carried out with an eye to the detection of the onset of effects of heat. Useful guides are irritability, changed personality and urine chloride content. Minor changes in general health may be due to effects of heat. Men who have mild febrile complaints or who are recovering from some illness should be kept under constant observation.

Health Education.—The problem to be faced must be explained simply to the men and the measures necessary to avoid heat effects stated plainly. It is essential to avoid gloomy or alarmist attitudes to the problems as the psychological approach is important.

In the general policy of health education special efforts must be made to instruct officers so that they will not expect too much from their men or impose too arduous tasks on them.

Clothing.—Loose light mesh clothing is desirable. Looseness of fit, bellows action and permeability to moisture are important. The colour should be light as this is resistant to absorption of radiated heat. Much work

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was done during the war to find a suitable garment which would be insect-bite proof as well as cool. J. S. Weiner (1947) has reported on this work and it would seem that lightness and looseness of clothing is most important and permeability to air not so important. Utility gabardine of a light material and very close weave was found to be insect proof and cool.

ACCLIMATIZATION.—Sir John Megaw considers acclimatization does occur to a limited extent but bodily vigour soon begins to fail and the resistance to heat is lessened. Adolph (1947) found that in the course of one week of acclimatization an increase in tolerance of 10° F. wet bulb may be gained.

In Army experience, troops newly arrived in a hot area were very susceptible to effects of heat but physically fit seasoned troops could withstand severe conditions of heat. The long-term results of prolonged exposure to heat have not so far been assessed though Type II Heat Exhaustion described by Ladell is said to be due to lessened resistance from prolonged exposure to heat.

Early in the war troops were sent on long sea voyages to disembark in the tropics and fight almost at once. They travelled in idle and lazy circumstances because of the overcrowding of troopships and got out of condition rapidly. The folly of this was recognized and strict routine of physical training and health education was instituted with excellent results. The Army problem is to land a man fighting fit physically and in possession of all knowledge and equipment he requires to keep himself fit. With air travel much of this education must be done in the U.K. and the question of acclimatization may become very important.

SUN TAN.—If acquired gradually is useful and health giving.

FOOD.—Must be adequate in quantity, of good quality, well cooked and served so as to stimulate the appetite so that good health can be maintained. Care must be exercised in preparation of food to avoid intestinal diseases.

FLUID.—Very large quantities of water may be required and it is often difficult to get men to drink enough. Twenty pints a day are needed for ordinary work in a temperature of 115° F. and up to 4 gallons a day for heavy manual work, e.g. railway construction. The water should be cooled by canvas water bottles or porous earthenware vessels which cool by evaporation from the surface. The addition of a little salt may make the water more palatable.

Alcohol in the heat of the day is definitely dangerous—presumably due to its effect on the vasomotor system and possibly on the heat-regulating centre.

SALT INTAKE.—0.5 to 2.0 grammes sodium chloride are required per hour in hot weather depending on the work done. The Army ration for hot climates is ½ oz. + ¼ oz. (21·25 grammes) per day; ½ oz. is used in cooking, ¼ oz. for drinks. An additional ¼ oz. may be required for very heavy physical work. Ladell (1947) estimates that a man sweating 10 litres a day will require 35 grammes of sodium chloride, 15 grammes will come from his food and the rest will be taken as condiment or in drinks.

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REST.—Sufficient rest and sleep is essential. Sleep is best in the cool early morning hours. In this connexion there was a tendency on the part of inexperienced officers, especially of transport and supply units, to make their units work in the cool early hours of the morning. This was pleasant at first but the units gradually got tired and exhausted through lack of sleep and in the end these "best hours" had to be reserved for sleeping. Cool rest rooms and recreation rooms should be provided and special accommodation provided for night duty men.

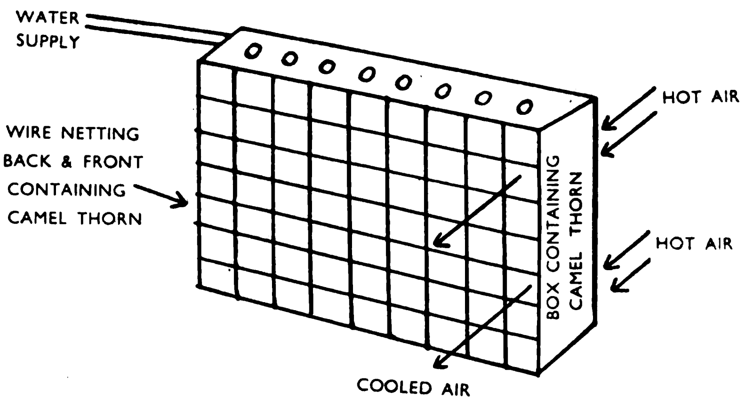
RECREATION.—Strenuous games should be curtailed but games, entertainment, cinemas and other interests are essential for the psychological welfare of the men. Welfare in all its aspects must be well organized.

LIVING QUARTERS.—These must be carefully planned and sited to protect them from the sun and to take full advantage of cool night breezes. Huts if needed can be built of native materials—mud, bricks, bamboo poles, chattai, etc.

Consideration may be given to digging down for protection from the sun but this has two main disadvantages. Full advantage cannot be taken of cool evening breezes; and dug down buildings tend to retain their heat at night. In the rainy season a very efficient drainage system is required to avoid flooding. Both the above disadvantages were experienced in a general hospital in Iraq.

Air-conditioning plant would be ideal for living quarters but is very expensive to instal and maintain and for field conditions is out of the question but improvised evaporative cooling can be used.

A simple and effective method, where relative humidity of the air is low, is to erect a box of camel thorn, through which the prevailing wind can blow (*See* fig.). Water is allowed to drip down over the camel thorn and as the air



passes through the camel thorn, it picks up moisture and a reduction in the temperature of the air results. One pound of water is required for each 100 c. ft. of air.

The above system raises the humidity of the atmosphere and this may be a disadvantage—to overcome this a heat exchange system can be devised to produce dry cool air.

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General Administrative Measures to Prevent Casualties from Effects of Heat in the Army.

Administrative Orders and Standing Orders are published to cover the points discussed in "prevention" and, in addition, medical instructions are issued which provide for the establishment of heat-stroke centres and water stations at medical inspection rooms, general hospitals, docks, railway stations and for mobile heat stroke centres which are made available on railway trains and motor transport columns.

Details of equipment for such centres are given in a memorandum issued by G.H.Q. Persia and Iraq Force in 1943.

Sixty-five per cent of all cases that occurred in the Persian Gulf Area between May and September, 1942, were in men newly arrived in the tropics and they occurred either on board ship, during disembarkation or shortly after landing. A concentrated preventive campaign on these points was bound to produce good results. Incidents involving large numbers of cases of heat stroke were due to lack of thought on the part of disembarking authorities. Men, who had been seasick and were thereby hungry and thirsty, were made to march with heavy loads and in temperatures up to 116° F. with relative humidity of 23·5 per cent; the results were disastrous. Disembarkation authorities and reception camps staffs were made to handle disembarking troops with consideration.

Measures recommended to prevent the occurrence of Heat Stroke on board ship included lectures and instruction to the men on how to keep fit, how to avoid constipation, and on the importance of taking enough salt and enough water. General physical fitness was considered very important. Ample supplies of cool drinking water and extra salt had to be available and had to be consumed.

Ventilation of accommodation had to be checked to ensure that best advantage was taken of fans and air ducts.

Special care was required to keep food service up to a high standard. Medical inspection of troops had to be carried out to pick out susceptible types, and officers who knew their men had to watch them for slight changes in physical conditions and temperament.

Great importance was laid on good "man management" by officers.

Provision had to be made on board ship for a cool place for cases suffering from slight effects of heat and also for true cases of heat hyperpyrexia.

Special care was also required in field hospitals, as patients with slight febrile conditions were liable to develop hyperpyrexia rapidly. This entailed a strict routine of watching and observing patients, which was a very arduous task for small night duty staffs during hot weather, especially if patients were sleeping under mosquito nets. Surgical operations which were not of an absolutely essential nature should not be done as general anæsthetics and atropine are dangerous. Atropine and belladonna definitely predisposed to hyperpyrexia and it was considered, without adequate proof however, that sulpha drugs also predisposed to effects of heat.

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Summary.

The incidence of effects of heat in the Army is discussed with a suggestion that loss of efficiency both mental and physical is probably considerable even where no obvious cases of heat exhaustion or heat stroke occur.

The ætiology, pathology, symptomatology and clinical observations of the various types of effects of heat met with in the Army are discussed along with the treatment and preventive measures recommended.

As far as can be seen effects of heat are really due to pure water depletion, salt depletion, or a combination of both, and the occurrence of these conditions is not confined to tropical climates.

The treatment must be based on the estimation of the extent of the water and/or salt depletion.

The prevention depends to a large extent on health education or instruction, and on careful handling of the men by their officers.

Conclusion.

That there is a loss of efficiency in doing physical work and a loss of capacity for mental work may be accepted from the evidence produced by various workers. In industry further work is required to assess the exact conditions under which efficiency both mental and physical will be maximal and, in tropical conditions, further study of prodromal signs and symptoms will be essential to aid in the prevention of frank cases of heat stroke.

The assessment of loss of mental capacity entails prolonged experiments and may not easily be carried out in peacetime.

The measurement of environmental conditions requires the adoption of a uniform system of recording observations. The corrected effective temperature as recommended by Bedford is probably best as it does include effects of radiant heat.

Further work, however, on the effect of radiant heat is necessary. The Army Medical Services still adhere to the wet bulb temperature as the best measure at high temperatures.

As far as the Army is concerned, during war conditions the risk of casualties from heat must be accepted but should be minimized by selection of personnel. Education of these suitable personnel in methods of prevention, and the provision of adequate food, clothing, water, salt and, if possible, accommodation. Periodical medical examination—a sheet-anchor in preventive industrial medicine—is carried out as routine in the Army and if done intelligently with attention to minor alterations in mental state of men, minor deviations in general health, and in urine chloride content, incipient cases may be picked out at an early stage and the more severe effects prevented. Further study is also required of the long-term effects of prolonged exposure to high temperatures.

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TRAUMATIC ARTERIOVENOUS FISTULA: TREATMENT AND RESULTS

BY

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A TRAUMATIC arteriovenous fistula is the result of simultaneous injury to an adjacent artery and vein. There are two types of communication: aneurysmal varix and varicose aneurysm. In aneurysmal varix the vessels communicate directly and in varicose aneurysm a false aneurysmal sac is interposed between the communicating vessels or is attached to either artery or vein.

Since 1757 when William Hunter described a case of arteriovenous aneurysm, much has been recorded from experimental and clinical observation to establish the principles of its diagnosis and treatment. From time to time also the literature on the subject has been exhaustively reviewed (Callender, 1920; Holman, 1937; Albright and Hale, 1946). War provides an opportunity for observations on traumatic fistulæ, on account of their increased incidence in wounds caused by sharp weapons and by such high-velocity projectiles as shell or bomb fragments and bullets.

A unique contribution was made by Makins (1919, 1922) in his comprehensive study of gunshot injuries to blood vessels in the 1914–18 War. During and since the second World War (1939–45) much of value has been added to our knowledge of arteriovenous aneurysms. However, most observations have been concerned mainly with the early results of treatment and the present paper reviews treatment and its late results in a small number of cases.

Clinical Material.

A review has been carried out of 26 cases of traumatic arteriovenous fistula which had been admitted to the Peripheral Vascular and Nerve Injuries Unit, Gogarburn E.M.S. Hospital, Edinburgh, during the period 1942–46. Table I gives details of the cases; there were 27 fistulæ in 26 patients. The majority of the lesions had been caused by high-velocity projectiles; ten lesions were due to bullets and thirteen to fragments of shell, mortar bomb, grenade or mine. In three cases the wounds had resulted from trauma by a sharp-edged object, a knife, a broken window and the jagged edge of a fractured bone. The patients were all men whose ages ranged from 18 to 43 years and thirteen were in the third decade. In 22 cases operative treatment of the fistulæ was performed at the Neurovascular Unit by Professor J. R. Learmonth (20 cases) and by Mr. (now Professor) Ian Aird (2 cases). Two fistulæ were cured overseas;

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Case 23 in Italy by Mr. J. J. Mason Brown (then T/Lt.-Col., R.A.M.C.) and Case 11 in India by Mr. A. J. Slessor (then T/Lt.-Col., R.A.M.C.). Two other cases (Nos. 18 and 21), both popliteal varicose aneurysms, were not cured of their fistulæ; Case 21 underwent an amputation of the affected limb for secondary hæmorrhage and Case 18 died on the operating table at the conclusion of a lumbar sympathectomy.

Distribution and Types of Lesion.

Table II shows the regional distribution and types of arteriovenous fistulæ which occurred.

Table II.—Regional Distribution and Types of Arteriovenous Fistula.

Region	*Total fistulæ*	*Aneurysmal varix*	*Varicose aneurysm*
Neck	4	2	2
Upper limb ..	8	1	7
Lower limb ..	15	3	12
Total	27	6	21

The lower limb was the most frequent site of the fistula and varicose aneurysm was the commoner lesion. Two unusual variations occurred: Case 3, already described (Learmonth, 1944*a*), had a varicose aneurysm involving two arteries, the common carotid and vertebral arteries. In Case 4 (fig. 1) a

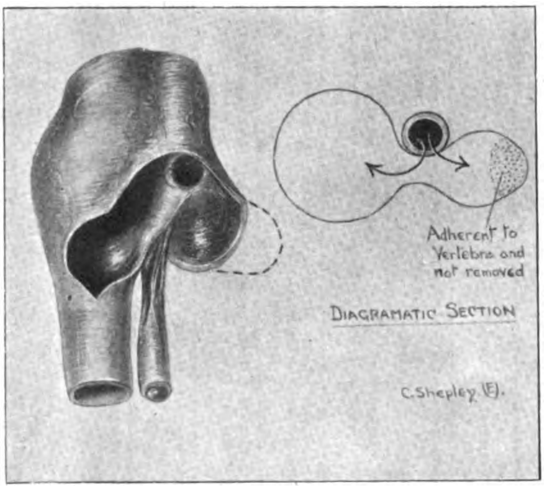

Fig. 1.—Case 4: Diagram of excised varicose aneurysm in which the proximal end of the divided common carotid artery (narrow vessel) opened into a dilated and saccular internal jugular vein.

bullet lodging in the neck severed the common carotid artery, sealing the distal stump by thrombosis and causing the proximal end to communicate directly with the internal jugular vein.

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TABLE I.—DETAILS OF CASES OF TRAUMATIC ARTERIOVENOUS ANEURYSM

Case No.	Age Yrs.	Missile	Lesion	Vessels involved	Nerve injury	Time wound to operation	Operation	Time since op. (Follow-up)	Peripheral pulses (Follow-up)	Skin nutrition (Follow-up)	Girth of limb (Follow-up)	Motor power (Follow-up)	Sensory loss (Follow-up)	Employment (Follow-up)	Remarks (Follow-up)
1	21	Shrapnel	A.V.	Rt. occipital a. Int. jug. vein	IX, X, XII neurolysis	4 mths.	Quadruple ligature and excision	Yrs. 3½	+	Good	Normal	X, I.S.Q. XII, some improvement		Full-time contractor's handyman	Irregular spells of dull throbbing rt.-sided headaches
2	32	Shrapnel	A.V.	Lt. int. carotid a. Int. jug. vein	Cervical sympathetic	7 mths.	Repair a. ligation fistula. Excision vein segment	2½	+	Good				Full - time paper cutter	Int. carotid a. ligated 2 wks. after injury, then common carotid a. 1 month later. Now has occ. heaviness over Lt. eyebrow. Lt. Horner's syndrome persists
3	43	Grenade	V.A.	Lt. com. carotid a. Vertebral a. Int. jug. vein.	Cervical sympathetic	1 mth.	Excision	3 8/12	+	Good				Unable to work	Headaches, dizziness, insomnia and occ. blackouts ?functional. Lt. Horner's syndrome persists
4	20	Bullet	V.A.	Lt. com. carotid a. Int. jug. vein	Cervical sympathetic X. neurolysis	8 mths.	Quadruple ligature and excision	2½	+	Good		X, normal		Full - time trainee hotel manager	Occ. giddiness when tired or stooping. Horner's syndrome persists
5	28	Mortar bomb	A.V.	Right axillary vessels 1st part	—	6½ mths.	Excision arterial segment. Ligation fistula	2	—	Good	Normal	Slight weakness Rt. arm when pulling	Tip of index finger and thumb	Full - time rail signalman	During operation Rt. clavicle divided for access, then wired. Now firmly united
6	28	Mine	V.A.	Right axillary vessels 3rd part	Ulnar nerve (neuroma) neurolysis	3 mths.	Quadruple ligature and excision	2½	+ weak	Good	−1 cm.	Weakness (ulnar n.)	Slight	Full - time labourer	Some improvement in ulnar nerve lesion
7	29	Bullet	V.A.	Left axillary a. and v. 3rd part	Ulnar nerve in sac. Resection and suture	3 mths.	Quadruple ligature and partial excision sac	1¾	+ weak	Good	−1 cm.	Weakness (ulnar N.)	Ulnar nerve area of hand	Back to duty. Soldier	Some improvement after ulnar nerve suture
8	26	Bullet	V.A.	Right brachial vessels	Radial nerve. Partial division and suture	3 mths.	Quadruple ligature and excision	1 8/12	—	Good	−2 cm.	Weak wrist and hand	I.S.Q.	Full - time business	Little improvement after radial nerve suture. Profunda brachii pulse present
9	34	Mortar bomb	V.A.	Left brachial artery. Basilic v.	Median nerve. Partial div. Excision and suture	2½ mths.	Repair a. Excision venous segment and sac	2½	+	Good	−1·5 cm.	Weak	I.S.Q.	Full - time mattress maker	Little improvement in median nerve lesion
10	24	Bullet	V.A.	Left brachial artery. Basilic v.	—	10 mths.	Quadruple ligature and excision	1½	+	Good	−2 cm.	Slight weakness Good	Slight hypæsthesia and hypolagesia hand	Light duties joiner	Also had ischæmic foot and sciatic nerve following ligature of injured Rt. femoral a.
11	31	Bullet	V.A.	Left brachial vessels	Incomplete lesion ulnar nerve	4 mths.	Quadruple ligature and excision	3	+	Good	−1·5 cm.	I.S.Q.	I.S.Q.	Full - time clerk	
12	18½	Laceration with glass	V.A.	Left brachial artery. Median cubital v.	—	2 10/12 years	Quadruple ligature and excision	4 5/12	+ weak	Good	−1 cm.	Good	—	Full - time engineer	
13	28	Bullet	V.A.	Rt. sup. femoral a. Femoral v.	—	4 mths.	Excision art. segment and sac. Repair of vein	Yrs. 1 11/12	+	Good	+1 cm.	Good	—	Full - time glass worker	Headaches. Calf tender and stiff with exercise. Leg and foot swollen at nights
			A.V.	[illegible]	—	1 year	[illegible]	[illegible]							

14	26	Knife	V.A.	Rt. sup. femoral a. Lat. circumflex vein	—	3 mths.	Excision art. segment. Ligature vein. Obliteration sac	8 mths.	+	Good	Normal	Good	—	Full - time butcher	Excellent result
15	28	Bullet	V.A.	Rt. prof. femoris a. Femoral v. Saphenous vein	—	2 mths.	Excision art. segment and sac. Ligature of vein	2 7/12 yrs.	+	Good	Normal	Good	—	Full - duty soldier	Excellent result
16	38	Mortar shell	V.A.	Rt. prof. femoris a. Femoral vein	—	11 mths.	Quadruple ligature and excision sac	1 11/12 yrs.	+	Good	Normal	Good	—	Full - duty Army officer	Occasional puffiness leg associated with patch of dermatitis
17	20	Bullet	V.A.	Rt. medial fem. circumflex a. Femoral v. Prof. fem. v.	—	4 mths.	Ligature prof. a. Obliteration med. circ. art. Division prof. v. ligature fem. v.	2 mths. last seen 1945	+	Good	+4 cm.	Good	—	—	Untraced in 1947
18	32	Mortar bomb	V.A.	Left popliteal vessels	—	8 mths.	Lumbar sympathectomy	—	—	—	—	—	—	—	Died at end of sympathectomy
19	24	Shell	V.A.	Right popliteal vessels	—	3 mths.	Quadruple ligature and excision. Obliteration sac	2 5/12 yrs.	+	Good	+1 cm.	Good. Slight wasting sole muscles: calf firm	Sural area foot	Full - time farmworker	Tightness in calf after 1 mile walk, subsides with rest. Occ. swelling at night
20	34	Mortar bomb	V.A.	Right popliteal vessels	—	3 mths.	Quadruple ligature and excision	2 5/12 yrs.	+ weak	Good	−1 cm.	Wasting from calf muscle damage	—	Full - time long-distance lorry driver	Pain in calf after walking 1 mile, subsides after stopping 1-2 mins.
21	18	Bullet	V.A.	Left popliteal vessels	—	1 mth.	Amputation above knee	Last seen 1944	—	—	—	—	—	German P.o.W.	Untraced 1947. Amputation for sec. hæmorrhage for sepsis.
22	19	Shell	V.A.	Left popliteal vessels	—	7 mths.	Quadruple ligation and excision sac	1 7/12 yrs.	+	Good	+5·5 cm. but other calf wasted	Good	—	Light duties bakery	Calf firm and gets stiff after walking 3 miles; also had complete division 1st popliteal nerve other leg
23	32	Shell	V.A.	Left popliteal vessels	—	2 mths.	Repair a. Ligature v. Obliteration sac	2 4/12 yrs.	+	Good	+1 cm.	Good	Saphenous area	Full - time bank clerk	Slight swelling calf at nights.
24	19	Mine	V.A.	Rt. poplit. ant. and post tibial vessels	—	7 mths.	Quadruple ligature and excision and (2 mths. later lumbar sympathectomy)	1½ yrs.	+	Good	+0·5	Ant. tibial group damaged; peronei active	Tingling under heel (post tibial)	Full - time handyman in bakery	Leg and foot often swollen at nights; wears toe spring right foot
25	23	Road accident, fracture left tib. and fib.	A.V.	Left. post. tibial vessels	Partial division medial popliteal nerve at fracture site. Neurolysis	4½ mths.	Excision art. segment. Obliteration vein	1 4/12 yrs.	+	+	−1 cm.	Sole muscles weak	Paræsthesia and impaired sensation in post tibial N. area sole	Full - time ship's painter	Fracture lower 1/3 tibia and fibula united. Foot sensitive to cold
26	19	Bullet	A.V.	Left post. tibial vessels	—	5 mths.	Quadruple ligature and excision	1 5/12 yrs.	+	+	+1·5 cm.	Calf muscles weak	—	Full - time range fitter	Tightness in calf after walking 2 miles, relieved by rest. Comminuted fracture upper ⅓ left tibia without displacement

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The arteries involved in the arteriovenous communications were:—

Neck		*Upper Limb*		*Lower Limb*	
Common carotid ...	1	Axillary	3	Superficial femoral...	2
Common carotid and vertebral	1	Brachial	5	Profunda femoris ...	3
Internal carotid ...	1	Total	8	Medial femoral circumflex	1
Occipital	1			Popliteal	6
Total	4			Popliteal with anterior and posterior tibials	1
				Posterior tibial ...	2
				Total	15

Associated Injuries.

A number of patients had multiple injuries but mention is made here of those injuries in the vicinity of the arteriovenous fistula. In two cases there was associated bone injury; in Case 25 a compound fracture of the bones of the left leg was sustained in a road accident and the sharp edge of one of the fragments was the cause of an aneurysmal varix of the distal part of the posterior tibial vessels. In Case 26 an accidental bullet wound at short range caused a compound comminuted fracture of the upper third of the left tibia and a fistula between the posterior tibial vessels.

Two patients had infected wounds: one, Case 20, had mortar bomb wounds of the right calf and compound fractures of the metatarsus. The wounds were necrotic and gas was present; *Clostridium welchii* was cultivated from the wounds. Following a prolonged course of penicillin, and with drainage, the wounds healed after nearly two months. The other patient, Case 21, had a septic bullet wound of his left knee, the wound being infected with *B. Coli, B. pyocyaneus* and non-hæmolytic streptococci. In spite of chemotherapy a purulent discharge persisted and three weeks later an above-knee amputation became necessary for secondary hæmorrhage: a popliteal arteriovenous fistula was present.

Of the 26 cases 10 had associated nerve injury mainly due to the initial trauma. These lesions occurred in the 4 patients with wounds of the neck, in 5 upper limb cases and in only one of the 15 lower limb cases (Table III).

Attention has been drawn (Elkin and Woodhall, 1944) to the frequency with which injury to blood vessels high in the neck is associated with damage to all the last four cranial nerves. In Case 1, however, the spinal accessory nerve was spared although the bomb fragment which lodged at the base of the skull damaged the glossopharyngeal, vagus and hypoglossal nerves and caused an arteriovenous fistula to develop between the occipital artery and internal jugular vein. In Case 4 there was a Horner's syndrome but no clinical evidence of any other nerve lesion although at operation on a fistula of the common carotid artery a neuroma was seen on the vagus nerve, which was embedded in scar tissue. Exploration and repair, where feasible, of the

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damaged nerve was carried out at the same operation at which the fistula was eradicated. Nerve repair was carried out in three cases and neurolysis in four.

TABLE III.—ASSOCIATED NERVE INJURIES.

Region	*Nerve*	*No. of cases*	*Lesion*	*Treatment*
Neck ..	IXth, Xth, XIIth cranial	1	Involved in scar tissue	Neurolysis of XIIth
	Xth cranial and cervical sympathetic	1	Neuroma of Xth cranial	Neurolysis of Xth
	Cervical sympathetic	2	Not ascertained	Nil
Upper limb..	Ulnar	3	Neuroma 1 Involved in sac 1 Incomplete 1	Neurolysis resection and suture nil
	Median	1	Partial division	Resection and suture
	Radial	1	Partial division	Suture
Lower limb..	Medial popliteal	1	Partial division	Neurolysis

CLINICAL FEATURES.

Five patients did not complain of symptoms referable to their fistula. In one of them (Case 22) a popliteal thrill was accidentally felt in the left leg while it was being steadied during an examination of a nerve lesion in the opposite limb. The patient denied that he had been wounded in the left leg, but a minute scar was found and X-ray revealed a metallic foreign body in the popliteal fossa (figs. 2 and 3). In Case 5 the signs of an axillary arteriovenous aneurysm were discovered in the patient during a routine unit medical inspection six months after he had been wounded.

Symptoms of the fistula were complained of immediately by 4 patients and

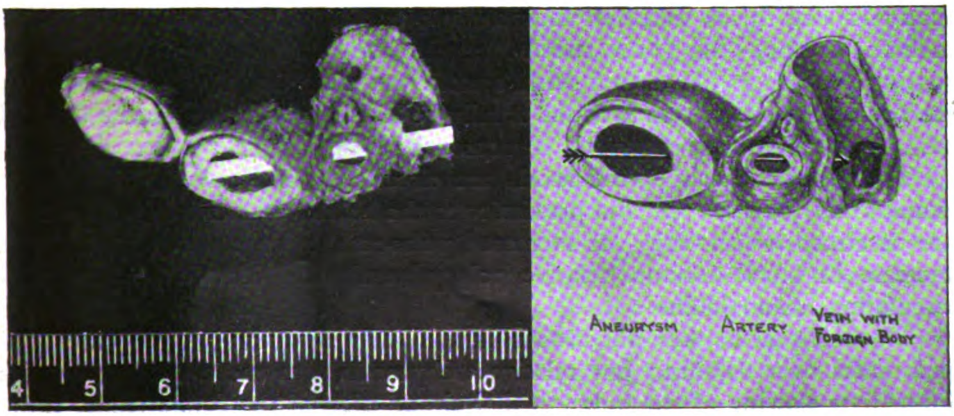

FIG. 2.—Case 22: Specimen and diagram of excised popliteal varicose aneurysm. The arrow indicates the track of the missile and fistula.

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FIG. 3.—Case 22: Radiographs showing the missile in the popliteal fossa.

by 15 patients within the first month after wounding. The complaint was usually of buzzing, throbbing, thudding or thrill in the region of the wound, often accompanied by local swelling.

Dilatation and occasionally tortuosity of the local superficial veins was observed in less than half the cases. Pulsation in these veins was absent in all but one patient (Case 12). Swelling of the parts distal to the lesion was observed in 12 cases.

The presence of a thrill and, on auscultation, a characteristic murmur, permitted recognition and localization of the fistula. The thrills were variable in quality and those which were more easily palpable displayed systolic accentuation. The thrills were felt maximally over the leak and were propagated in both directions along the affected vessels. The murmur was a continuous roaring machinery-like sound with systolic accentuation, heard loudest over the fistula, the site of which could usually be located accurately by the method of "auscultation at a distance" (Learmonth, 1946).

The general effects of the fistula are circulatory and are directly proportional to its duration, size and proximity to the heart. The circulatory changes are described as consisting of increased pulse-rate, enlargement of the heart, increase in blood volume, relative polycythæmia and increase in the total circulating hæmoglobin.

The tachycardia was not always immediately obvious: only 3 cases had pulse-rates over 84/min.; but relative tachycardia was made evident by the immediate slowing of the pulse on digital occlusion of the fistula (Ross, 1946), the Branham phenomenon which was a valuable diagnostic sign. It was also confirmed (Learmonth, 1946) that compared with the immediate slowing

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of the pulse on compression of the fistula, the pulse returned more gradually to its previous rate when compression had been released (Maybury, 1946) (fig. 4).

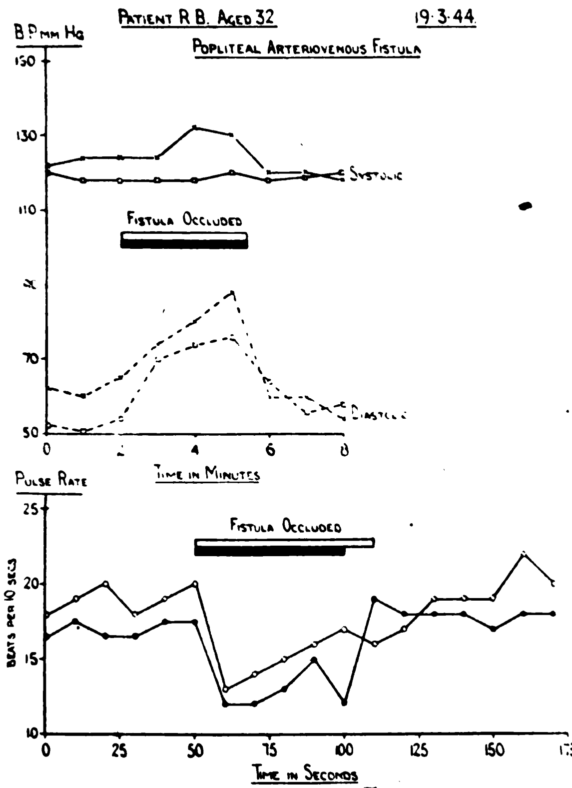

FIG. 4.—Case 18 : Effect of digital occlusion of the fistula on the pulse-rate and blood pressure. In one the pulse-rate (line with blank circles) does not return immediately to its previous rate after release of compression.

An increased pulse pressure was usually more obvious in this series than lowering of the diastolic pressure but the feature of diagnostic significance was the rise in diastolic pressure which took place on obliterating the leak.

In less than half the patients cardiac murmurs were heard; they were more generally systolic in time, soft and audible in all areas. Although not a diagnostic feature (Ross, 1946), an ominous effect of an arteriovenous fistula is enlargement of the heart. The mechanism of this was studied experimentally in animals (Drury and Wightman, 1940) and it was found that the change included hypertrophy and dilatation and that hypertrophy was greatest in the auricles. These changes appeared to be due to increased cardiac output owing to the raised auricular pressure which resulted from the leak, and this has been confirmed in man (McMichael and Sharpey-Schafer, 1944). The size of the fistula is considered (Elkin and Warren, 1947) to be a more important factor than its proximity to the heart in the production of increased cardiac output.

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in the other. In the latter patient (Case 24) it was a prophylactic lo
measure carried out after excision of a popliteal fistula in spite of a
vasomotor response in the foot, because of the gross muscle destruc
affected leg.

In dealing with the fistulæ, incisions giving a wide exposure and
extension were employed. Strict asepsis and hæmostasis were
intravenous drip infusions were set up preoperatively in three
lower limb cases when exposure had been expected to be
hæmorrhage likely. Fresh blood was given in six of these cases and
tion. Tourniquets were used in five lower limb cases and
sphygmomanometer cuff was employed but inflated only du
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to important small collateral vessels was not always
occasional brisk hæmorrhage.

In common with the experience of others (Ross
1946; Elkin, 1946), repair of the vessels was seldom
of the fistulæ were small and a number were
Quadruple ligation and excision of the sac was
choice. The operations carried out were:

Quadruple ligation and excision — 10 (with excision
Quadruple ligation — 4
Repair of artery — 2
Repair of vein

Included in these operative procedures were the
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Late Results.

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remaining 24 patients whose fistulæ were dealt with, 19 were seen lly examined at the Royal Infirmary, Edinburgh; reports were our patients who were out of the country and one (Case 17) was Excluding this last patient the period which had elapsed since tment of the arteriovenous fistula varied from eight months to f years; in 19 cases one to three years had elapsed since operation. ases which were followed up the results of operative treatment y and cure of the fistula was achieved, there being no evidence of a missed fistula.

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General Effects.

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term "reversible heart" (Matas and Heninger, 1939) tive in cases of arteriovenous fistula for in this series the radiographically some six weeks after operation, showed which would appear to represent the normal when the had been modified by considerable effort. Late follow- well below preoperative values with one exception (Case had two adjacent fistulæ in his right thigh. After art size markedly diminished and then slowly was occluded when it became stationary at ble V and fig. 5).

of a year, showed an increase in and were consistent with the ince his operation. This other cases who had at it is not always the patients are

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In this series of cases 4 were suspected to have early cardiac decompensation but only three showed clinical evidence of cardiac enlargement, which was confirmed by radiographic measurement. Radiography also revealed a number of cases in which the heart was not obviously enlarged beyond normal standards and yet subsequently showed a diminution in size after closure of the fistula. Radiographic measurements of the heart area and transverse diameter were made for comparison before and after closure of the fistula. These measurements depended on so many factors that they could at best only be a means of comparing the obviously enlarged with the obviously normal heart (Schwedel, 1946). Professor R. McWhirter and Dr. W. S. Shearer, who carried out the measurements at the Royal Infirmary, Edinburgh, took pains to obtain absolutely comparable radiographs. The heart size varied with the age and physique of the patient and with the duration, size and site of the leak. The earliest enlargement was detected two months after injury and was greatest in a man (Case 5) whose fistula had been overlooked; he was a soldier whose shoulder wounds had healed quickly, allowing him to return to strenuous Army duty. The effect of the size of the leak was seen in Case 13 in which there were two fistulæ in the thigh (fig. 5).

In patients from this series it was shown (Roscoe and Donaldson, 1946) that increased blood volume and a relative polycythæmia were present, although increase in total circulating hæmoglobin was the more constant feature.

Arteriography (Learmonth, 1944*b*) was not usually found necessary for localization of the fistulæ although it was used in three cases to assist in determining the level of approach to a popliteal lesion.

The adequacy of the collateral circulation in this series was generally good as assessed by the colour and warmth of the limb, the presence and quality of the distal pulses and more accurately, where necessary, by recording skin temperatures and using the reactive hyperæmia test.

TREATMENT.

In two cases (Nos. 1 and 2) previous unsuccessful attempts had been made elsewhere to deal with the fistula. Both patients had lesions in the neck: one, Case 1, had had an unsuccessful exploration for the lesion carried out six weeks after wounding and two and a half months later at the Neurovascular Unit, an anaeurysmal varix of the occipital artery and internal jugular vein was excised after quadruple ligation. The other (Case 2) had had ligations without relief first of the internal and then of the common carotid artery two weeks and three months respectively after wounding. At the Neurovascular Unit, three and a half months later, a successful ligation was effected of a fistula between the internal carotid artery and internal jugular vein.

Spontaneous healing by thrombosis was observed in one case (No. 9) in which there was a fistula between the brachial artery and basilic vein. This was confirmed during exploration of an associated median nerve lesion and the thrombosed venous sac was excised. Apart from this case, and because of the tendency of fistulæ to enlarge and to cause serious systemic effects, all the fistulæ were treated by operation, but none was dealt with as an emergency.

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Allowing for the duration of the lesion on admission to the Neurovascular Unit, the main factors determining the optimun time for definitive treatment were the condition of the wound, the state of the collateral circulation and the presence of a nerve lesion. Operation was carried out after sound healing of wounds and after the establishment of an adequate collateral circulation. Table IV shows the interval which elapsed between wounding and closure of of the fistulæ and it will be seen that 16 of the 25 fistulæ were operated upon within six months of their production. A little more patience was required in the case of the lower limb lesions than in the upper owing to the less profuse collateral circulation in the former, and a delay of over four months was necessary in 8 of the 13 lower limb cases especially in lesions of the popliteal artery whose collateral branches are limited in number.

TABLE IV.—TIME OF OPERATIVE CLOSURE OF FISTULÆ

Time since wound (months)	*Neck*	*Upper limb*	*Lower limb*	*Total fistulæ*
–3	1	4	5	10
4–6	1	1	4	6
6–12	2	2	3	7
1 year +	—	1	1	2
Total	4	8	13	25

Case 13 illustrates the wisdom of delay; this man had two fistulæ. Four months after wounding, a fistula between the superficial femoral artery and vein was closed with suture of the vein, but a second fistula later manifested itself in the same region. Operation was delayed for eight months to encourage the formation of a second collateral circulation and in the hope that, as it probably was an aneurysmal varix, spontaneous closure might take place. During the second operation a communication was found between the profunda artery and femoral vein, and the distal stump of the previously divided superficial femoral artery was observed to be pulsating strongly; this was reassuring evidence of a rich collateral circulation obtainable from the cruciate anastomosis in a fit young adult in whom damage to possible collateral vessels had been avoided.

No special measures were undertaken for the preoperative improvement of the collateral circulation except sympathectomy in one case (No. 18) and four patients were kept at rest in bed before operation because of suspected cardiac decompensation.

The sympathectomy which was carried out as a preliminary to closure of the fistula in Case 18 was performed on account of a poor vasomotor response in the foot in the presence of a left popliteal arteriovenous aneurysm with lesions of both popliteal nerves in the same limb. Unfortunately, the patient died for reasons unknown, at the end of an uneventful lumbar ganglionectomy which had lasted fifteen minutes. He was one of the two patients whose fistulæ never came to operation: the other (Case 21) had to have an above-knee amputation on account of a secondary hæmorrhage.

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Post-operative sympathetic interruption to improve the collateral circulation was performed in two cases, procaine block in one and lumbar sympathectomy in the other. In the latter patient (Case 24) it was a prophylactic long-term measure carried out after excision of a popliteal fistula in spite of a normal vasomotor response in the foot, because of the gross muscle destruction in the affected leg.

In dealing with the fistulæ, incisions giving a wide exposure and capable of extension were employed. Strict asepsis and hæmostasis were the rule and intravenous drip infusions were set up preoperatively in three neck and six lower limb cases when exposure had been expected to be difficult and hæmorrhage likely. Fresh blood was given in six of these cases during operation. Tourniquets were used in five lower limb cases and for this purpose a sphygmomanometer cuff was employed but inflated only during excision of the fistula, otherwise tapes were employed for control of the individual vessels close to the communication. Before ligation of the affected vessels it was important to ensure disappearance of the thrill and bruit by tightening the controlling tapes. In the majority of cases there was a good deal of scarring which necessitated painstaking dissection; thus the exposure of the fistula, the identification and division of small saccular tributaries and the avoidance of damage to important small collateral vessels was not always achieved without an occasional brisk hæmorrhage.

In common with the experience of others (Ross, 1946; Albright and Hale. 1946; Elkin, 1946), repair of the vessels was seldom possible, especially as most of the fistulæ were small and a number were accompanied by nerve damage. Quadruple ligation and excision of the sac was therefore the operation of choice. The operations carried out were:

Quadruple ligation	—	19 (with excision of sac in 15)
Repair of artery	—	4
Repair of vein	—	2

Included in these operative procedures were the six aneurysmal varices of which three were excised following quadruple ligation; in two the artery was spared and in another the vein was spared.

The patency of the vein was preserved in Case 5 (axillary vein) and Case 13 (femoral vein). In the latter case, unfortunately, the vein had to be ligated during the closure of a second fistula eight months later.

After operation the limb was wrapped in a sterile towel without any constrictive bandage and exposed to room temperatures under a cage. The head of the bed was raised to impede mildly the venous drainage of the limb. Reflex vasodilatation was induced and assisted by the judicious use of morphia or omnopon as sedatives of choice. As a rule, prophylactic chemotherapy was given with sulphathiazole which was started on the eve of the operation and continued for three to four days to a dosage of 20 grammes. Penicillin was, at that time, scarce and therefore was sparingly used, but three patients received it. Heparin was given to one case (No. 13) after repair of the artery at the closure of his second fistula.

The only early post-operative complications of consequence were a brisk

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reactionary hæmorrhage in a wound which was quickly controlled, the development of an urticarial rash which disappeared except for a residual patch of dermatitis and a flexion contracture of the knee which was corrected by physiotherapy.

Late Results.

In reviewing the late results of treatment, two patients (Cases 18 and 21) are not considered because their popliteal arteriovenous aneurysms were not operated upon: one (Case 18) died at the conclusion of a lumbar sympathectomy, and an amputation of the affected leg was performed in Case 21 for secondary hæmorrhage.

Of the remaining 24 patients whose fistulæ were dealt with, 19 were seen and personally examined at the Royal Infirmary, Edinburgh; reports were received of four patients who were out of the country and one (Case 17) was not traced. Excluding this last patient the period which had elapsed since operative treatment of the arteriovenous fistula varied from eight months to four and a half years; in 19 cases one to three years had elapsed since operation.

In the 23 cases which were followed up the results of operative treatment were satisfactory and cure of the fistula was achieved, there being no evidence of recurrence or of a missed fistula.

The effects investigated can be divided into general effects on the circulation and distributive effects in the local territory of the vessel involved.

General Effects.

Blood Pressure.—The diastolic blood pressure was found on follow-up in these patients to be maintained above the preoperative figure, usually between 5 and 30 mm.Hg higher, and where the main artery to the limb had been ligated the peripheral pressure in that limb was diminished compared to the normal.

Cardiac Size.—The term "reversible heart" (Matas and Heninger, 1939) is appropriately descriptive in cases of arteriovenous fistula for in this series the heart size, as measured radiographically some six weeks after operation, showed a diminution to a level which would appear to represent the normal when the condition of the heart had been modified by considerable effort. Late follow-up measurements were well below preoperative values with one exception (Case 13), the young man who had two adjacent fistulæ in his right thigh. After closure of one fistula the heart size markedly diminished and then slowly increased until the second fistula was occluded when it became stationary at about its second preoperative level (Table V and fig. 5).

The last readings, made after the lapse of a year, showed an increase in heart size in the absence of any further fistula and were consistent with the development and increase in weight of the patient since his operation. This late increase in radiographic heart size was noted in two other cases who had put on weight, in one as much as three stones, and shows that it is not always possible in a late follow-up strictly to compare the values when the patients are

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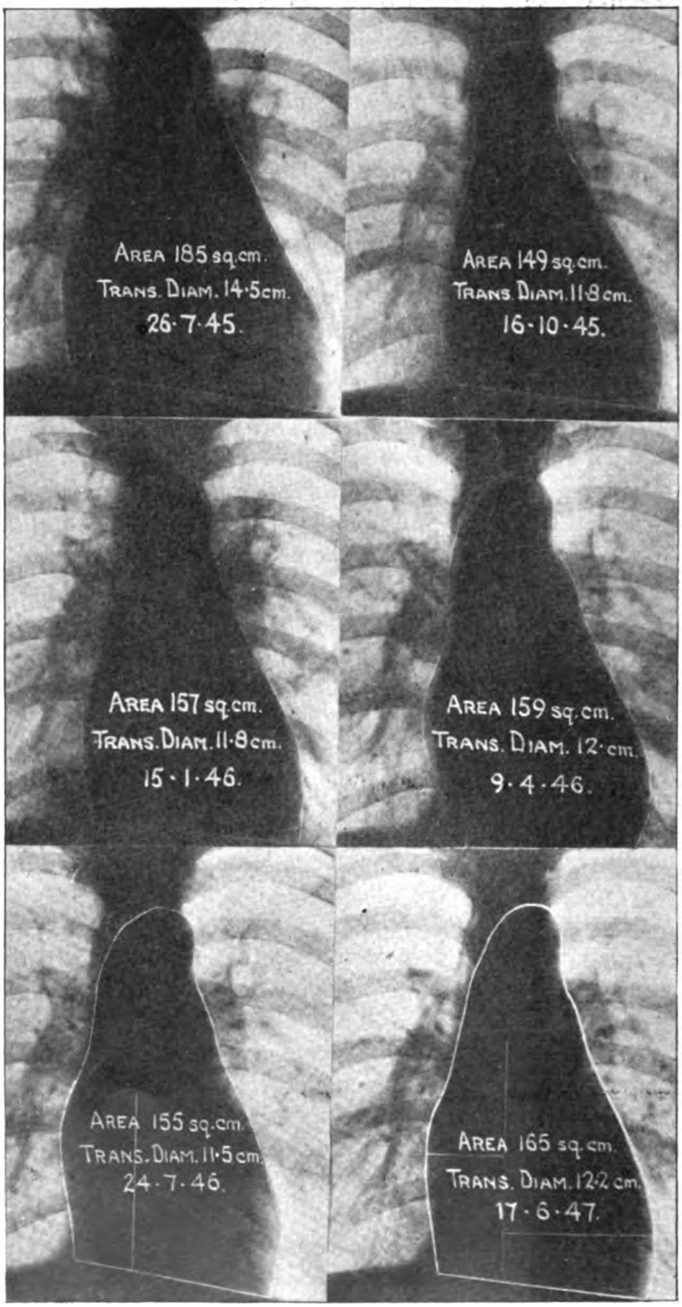

FIG. 5.—Case 13: Two adjacent arteriovenous fistulæ in thigh. Pre- and post-operative radiographs showing a decrease in heart size after operative closure on 30.7.45 and 1.3.46.

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TABLE V.—CARDIAC MEASUREMENTS: CASE 13, AGE 23 YEARS.

Date	Cardiac measurements: Area (sq. cm.)	Cardiac measurements: Transverse diameter (cm.)	Remarks
23.3.45	—	—	Bullet wound right thigh
26.7.45	185	14·5	
30.7.45	—	—	Operative closure of fistula of superficial femoral artery
16.10.45	149	11·8	
15.1.46	157	11·8	
1.3.46	—	—	Closure of fistula of profunda femoris artery
9.4.46	159	12·0	
24.7.46	155	11·5	
17.6.47	165	12·2	

growing young men in whom a moderate increase in heart size could be ascribed to normal development.

Other Cardiac Features.—The cardiac murmurs heard preoperatively usually disappeared after operation. No significant electrocardiographic abnormalities were noted before or after closure of the fistulæ.

Blood Volume.—Blood volume and total hæmoglobin estimations were not carried out in this late follow-up but elsewhere the results of investigation of cases in this series have been recorded (Roscoe and Donaldson, 1946). It was shown that within four to ten weeks after operative occlusion of the fistulæ there was a tendency for the blood volume and total hæmoglobin to decrease.

DISTRIBUTIVE EFFECTS.

Neck Lesions.—In four cases there was a fistula of the vessels in the neck. In three of these the common carotid artery was ligatured and in these the flow through the internal carotid was provided by the collateral circulation through the external carotid from the opposite side. In all four the internal jugular vein was obliterated. None of these patients was entirely free from symptoms, the usual complaint being of headache and giddiness on stooping. In Case 3 there were also blackouts in the streets and giddiness on rising from a sitting position; he had had an excision some three years before of a double arterio-venous aneurysm of the left common carotid and vertebral arteries and internal jugular vein. His attacks of giddiness and his blackouts were patterned in a curious way which suggested that they were partly functional, a view which was supported by the absence of neurological signs, and a negative encephalogram (carried out through the kindness of Professor Geoffrey Jefferson of Manchester). They were severe enough, however, to totally incapacitate the patient. Professor Learmonth, who reported this unusual case (Learmonth, 1944*a*), now feels he was premature in describing it as an example of complete interruption of the direct arterial supply to one side of the brain without resulting symptoms.

The other patients were regularly and gainfully occupied although occasion-

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ally each of them had to take a day off work because of the oppressive nature of his symptoms. The interruption of the common carotid artery may have played a part in the production of symptoms in three of the cases, otherwise the only factor common to all four was the obliteration of the internal jugular vein on one side. Complications of the nature described, however, do not generally result from removal of the jugular vein on one side in a block dissection of cervical glands and Douglas (1947) has found it safe to remove both internal jugular veins with a three months' interval between the two operations to permit the establishment of a venous collateral circulation.

Upper and Lower Limb Lesions.—All the patients followed up (8 upper limb, 11 lower limb) were in active employment. Only one upper limb case was symptom-free; two patients complained of slight weakness in the affected limb following interruption of the main artery and five had symptoms associated with a nerve lesion. Of the lower limb cases, three patients were symptomless: five had stiffness of the calf after exercise; two complained only of swelling of the leg at the end of the day and one man had symptoms attributable to his nerve lesion.

Skin Nutrition.—There was no loss of skin nutrition in any of the cases.

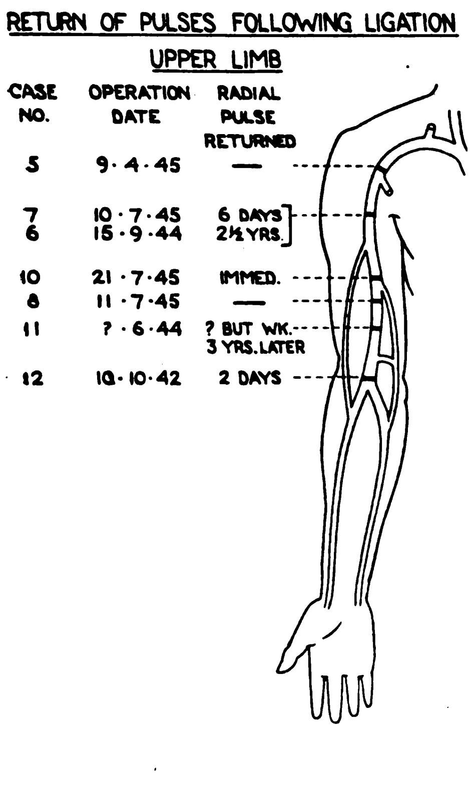

Fig. 6.—Diagram showing the time of return of distal pulses in the upper limb after ligation of the main artery.

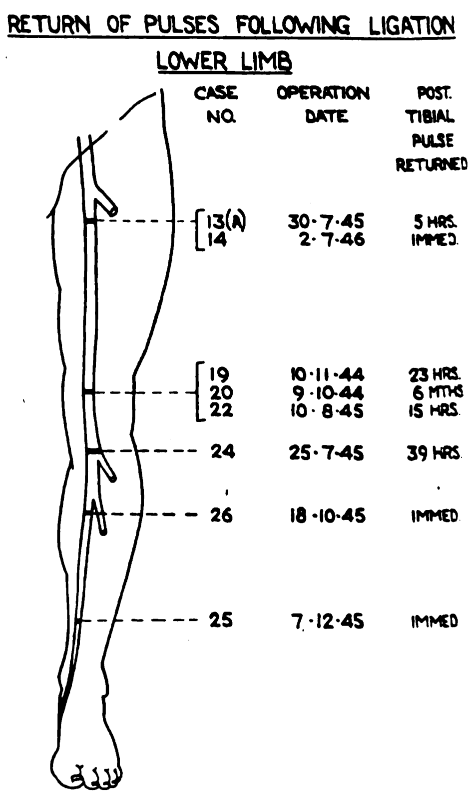

Fig. 7.—Diagram showing time of return of distal pulses in the lower limb after ligation of the main artery.

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Return of Pulses.—The time of return of normal distal pulses following ligation of the main artery of the limbs is shown in figs. 6 and 7. In the small number of upper limb ligations the return of the radial pulse varied widely, from immediately after operation to a delay of as much as two and a half years. In two cases (Nos. 5 and 8) the radial pulse did not return, but this did not imply failure of development of the collateral circulation for a distal pulse can be absent after a high ligation without ischæmic complications (M.R.C. War Memorandum No. 13, 1944). It was therefore not disturbing to find the radial pulse absent in Case 5 two years after ligature of the axillary artery (1st part). In Case 8 absence of the radial pulse more than one and a half years after brachial ligation was not understood. In both these cases, however, evidence of a collateral circulation was manifested by the appearance of an abnormal pulse—in Case 5 a weak posterior circumflex humeral pulse appearing two years after ligature and in Case 8 a profunda brachii pulse observed six months after ligation. Nor does the return of the radial pulse indicate cessation of the formation of the collateral circulation because in Case 10 a profunda brachii pulse became apparent six weeks after a radial pulse of good volume had been identified.

In the lower limb it was satisfactory to record that the posterior tibial pulse returned whatever the level of ligation in spite of considerable surrounding damage in some cases and even with ligation at the notorious popliteal segment. Case 24 was of particular interest in that a fistula at the popliteal bifurcation necessitated ligature of the popliteal, anterior and posterior tibial arteries. During the operation, which had been delayed to seven months after wounding, the collateral vessels about the knee were seen to be intact with the exception of the medial sural artery.

In all but two of the eight patients with main arterial ligations the posterior tibial pulse returned within a day and at the latest follow-up examination the pulses were of satisfactory volume though less than on the normal side. Not infrequently the posterior tibial pulse returned abruptly and, as might be expected, this coincided with the return of an adequate collateral circulation in the foot as evidenced by a rise in cutaneous temperature (fig. 8). In one patient (Case 13) the interval between ligation and return of the pulse was five hours and in another (Case 19) twenty-three hours. These observations are of interest since they show that the collateral circulation is re-established by an input into the main vessel as well as by the utilization of subcutaneous channels.

Motor Power.—In the neck lesions the only associated nerve lesion to show some improvement was the hypoglossal paralysis in Case 1. It is strange that the cervical sympathetic palsy in three cases should be unaffected by the passage of time in view of the inveterate tendency of sympathetic nerves elsewhere to regenerate.

In the eight upper limb cases, three patients without simultaneous nerve injury had good functional capacity of the hand without any significant wasting of the forearm muscles. In the other five patients the loss of motor power could be attributed to the associated nerve injury.

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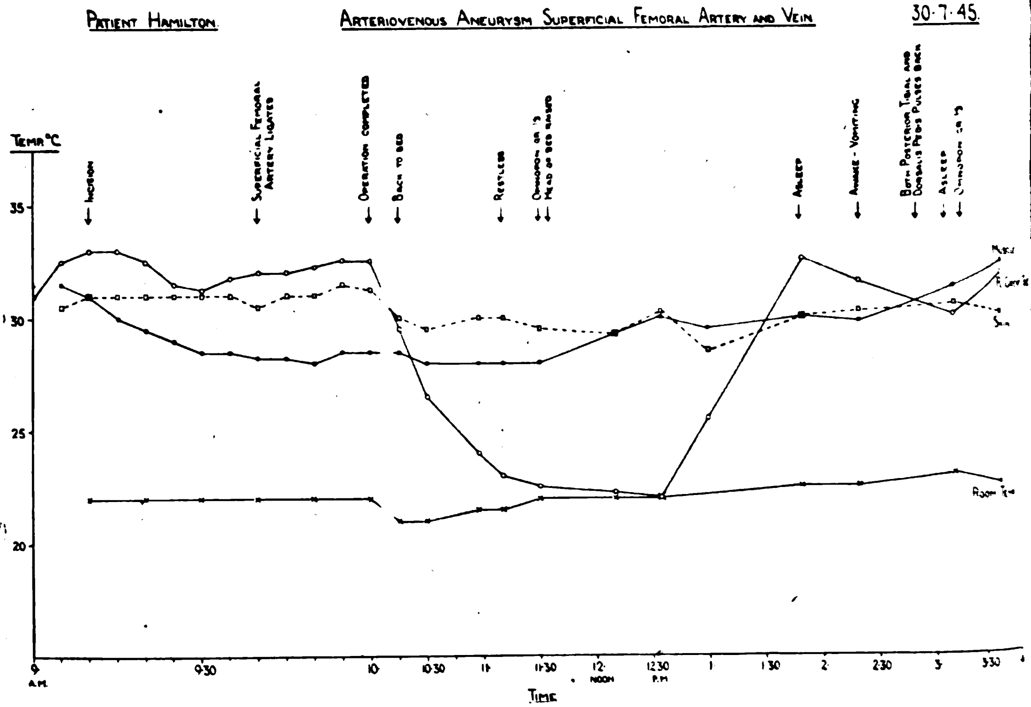

FIG. 8.—Case 13: Skin temperature readings made during and after operative closure of arteriovenous fistula superficial femoral artery. The distal pulses returned soon after restoration of temperature in the foot to its previous level.

The single lower limb case (Case 25) with an associated nerve lesion showed, on follow-up examination, symptoms attributable to the nerve lesion.

Four patients who had had fistulæ in the lower limb showed no functional incapacity and only one of these (Case 23) showed an increase in girth of the affected calf. He was a bank clerk in whom a transvenous repair of the popliteal artery had been carried out. He stood all day at his work and his only complaint was of slight swelling in the calf at night, subsiding with rest. This swelling was probably due to venous obstruction.

One patient (Case 24) showed relatively little impairment of motor power almost two years after ligation of all vessels at the popliteal bifurcation followed by lumbar ganglionectomy. Since then he had been working as a handyman in a bakery and his work, carried out in a hot atmosphere, was strenuous. He complained only of tiredness and swelling of the leg after a day's standing and, on measurement at the follow-up examination, the girth of the calf was slightly increased compared to the normal. This was a very satisfactory result considering that the main arterial supply to the leg and foot had been interrupted and that he had a permanent drop-foot due to gross muscle damage to the anterior tibial group of muscles.

Five patients complained of tightness in the affected calf after exercise, a

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symptom which was of the nature of the intermittent claudication of arterial obstruction as it subsided after a brief rest; this symptom could undoubtedly be attributed to arterial ligature. Three of these patients had had popliteal artery ligation and developed claudication after walking one to three miles. One patient (Case 13) had claudication after a half-mile walk and his right calf was found, on follow-up examination, to be slightly swollen compared to the normal. He had had two adjacent fistulæ in his right thigh treated by ligation of the superficial femoral artery and femoral vein, and repair of the profunda femoris artery somewhat reducing its calibre. The fifth patient (Case 26) to complain of tightness in the calf did so after a two-mile walk and also showed some swelling of the calf; a high ligation of the posterior tibial vessels had been carried out some seventeen months before and previous to that the anterior tibial artery had been ligated at a similar level. The assessment of ischæmic damage was difficult when swelling of the calf was present as it obscured any shrinkage of muscle mass. Increased girth of the affected calf was found in six cases and shrinkage alone in one. In all these the main artery and vein had been ligated and swelling was probably due to venous obstruction except in two patients (Cases 22 and 26). In Case 22 the difference in calf measurements was due to wasting of the opposite calf on account of a severe injury to the medial and lateral popliteal nerves. The swelling of the calf in Case 26 was probably due to untreated œdema arising during a long period of recumbency as his vascular lesion had complicated a compound comminuted fracture of the tibia.

Preservation of the vein has been advocated, whenever possible, in order to avoid the effects of venous obstruction (Ross, 1946) which are described as an aching pain and a bursting feeling in the lower part of the dependent leg when sitting or standing and relieved by walking or elevating the limb. Swelling at the ankle can also be present. In this series of cases discomfort of the nature described was not complained of and the symptom would seem to be due to more than venous obstruction since it does not follow ligation of the main vein for thrombosis when carried out by advocates of this procedure.

Sensation.—With the exception of those patients with nerve lesions only two (Cases 5 and 10) noted some sensory loss of an ischæmic nature and it would seem that with the re-establishment of the circulation a diminution in the extent of the so-called ischæmic anæsthesia can occur. One patient (Case 5) whose axillary artery (1st part) had been tied and whose only palpable pulse was a weak posterior circumflex humeral, had slight impairment of sensibility at the tips of the index finger and thumb but less than in the immediate post-operative period. In Case 10, following excision of a fistula of the brachial artery in mid-arm, there was a slight hypoæsthesia of glove distribution in the hand noticed by the patient when he handled money, and hypoalgesia of the fingers; the extent of this sensory impairment had been diminishing.

Acral sensitivity to cold following ligation of the main vessels was observed in only three cases who were free of nerve damage, and was not a serious disability though elsewhere (Shumaker and Carter, 1946) it has been reported in a number of cases.

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Routine Sympathectomy.

Sympathetic interruption has been recommended on experimental grounds (Deterling *et al.*, 1947) for the chronic vascular insufficiency which is a common pre- and post-operative feature of arteriovenous fistula. For similar reasons Ross (1946) and Boyd (1946) combined routine sympathectomy with the operative abolition of their arteriovenous aneurysms, and as a result of this their lower limb cases were able to walk at ordinary pace for reasonable distances without claudication. Sympathetic interruption is undoubtedly valuable in emergency arterial ligation or where early treatment of an arteriovenous fistula is necessary, because of complications, but this is infrequent, and, given a few months, an adequate collateral circulation usually develops. Operation in this series of cases was usually delayed until an adequate collateral circulation had developed, and a routine sympathectomy was therefore considered unnecessary. The late results in this small group of patients in whom skin nutrition and functional activity were on the whole good give the impression that routine sympathectomy in the treatment of traumatic arteriovenous fistulæ is an over-cautious measure and better kept in reserve.

Summary and Conclusions.

The clinical features, treatment and its results are described of 27 traumatic arteriovenous fistulæ in 26 patients.

The changes in pulse-rate and diastolic blood pressure on digital occlusion of the fistula were important in diagnosis.

Clinically and radiographically the heart was not, as a rule, enlarged though a post-operative diminution in size was observed.

The high incidence of combined vascular and nerve injury in the neck and arm complicated treatment and its results.

Operative closure of the fistula was delayed till the collateral circulation was established and adequate. Sympathectomy was not a routine procedure. The usual operation was quadruple ligation and excision of the sac and an associated nerve injury, if present, was dealt with at the same time.

The late results of treatment are considered in 23 patients who, with one exception, were gainfully employed. Good functional results were seen in the lower limb cases in which the peripheral pulses returned whatever the level of arterial ligation. Some had intermittent claudication of moderate degree and of ischæmic origin and a few had residual swelling probably due to venous obstruction.

In the neck cases the residual headache and giddiness could not be explained satisfactorily.

The results in the upper limbs were complicated by the associated nerve lesions.

The real evidence of successful treatment will probably be obtained in ten to twenty years' time when the vessels begin to lose their resilience and lead to nutritional phenomena.

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ACKNOWLEDGMENTS.

I am indebted to Professor J. R. Learmonth, at whose suggestion this paper was written, and who gave me much helpful advice. I am also grateful to the Chief Medical Officer, Department of Health for Scotland, for the use of case records from Gogarburn E.M.S. Hospital; to Professor R. McWhirter and Dr. W. S. Shearer for the radiological examinations; to the staff of the University Department of Surgery and Miss E. M. Davidson for their valuable assistance.

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PRESENTATION

On the handing over of his custodianship of the R.A.M.C. Funds, Lieut.-Colonel J. G. Foster, *O.B.E.*, was presented with an unusual token of the high esteem in which he is held by his brother officers. This was a Silver Salver with the inscription:

Presented
to
Lieut.-Colonel J. G. Foster, O.B.E., R.A.M.C. (Retired)
By some of his brother officers
in gratitude for
The long and loyal service he has rendered
to the
R.A.M.C. Funds.

It has engraved on it the facsimile signatures of fifty-three General officers, serving and retired, of the Army Medical Services, who were the subscribers.

It is a unique gift but a fitting one for an officer who has devoted so much of his time and spent so much of his energy in carrying out his invaluable work. He is beloved by all who know him and we wish him many years of peace and serenity in the evening of his days.

Reviews.

The Natural History of Disease. Second Edition. By John A. Ryle, M.A., M.D., F.R.C.P. London: Geoffrey Cumberlege, Oxford University Press. Pp. 484. Price 22s. 6d.

The advent of few second editions will be greeted with greater pleasure than this collection of its author's contributions to Medicine. Its prime aim, to foster the attitude of the naturalist in the approach to clinical science, requires sustenance in these times when achievements in the field of chemotherapy and antibiotics threaten to abort the course of many infections so that an intimate knowledge of their potentialities becomes increasingly difficult. The successes gained call for reliable assessments of mortality and morbidity, and cogent arguments are introduced for need of a wider, social interest in many infections.

For those who preoccupation remains more narrowly confined to the clinical aspects of disease, the relevant chapters, some of them now well-nigh classical, remain. The additions include a chapter on Prognosis, and one on Nosophobia. The latter contains a forcible presentation of the present-day "drift towards a more prevalent neurosis." The simple measures recommended to deal with this, "the psychiatric opportunity" of every general physician, surgeon and specialist, embodied as the summary and conclusions, are an embodiment of wisdom which we all might take unto ourselves and practise to the benefit of a "disease-conscious" generation.

J. B.

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THE APPENDIX. By R. J. McNeill Love, M.S., F.R.C.S., F.A.C.S. London: H. K. Lewis & Co. Ltd., 1947. Price 12s. 6d.

This little manual contains a clear exposition of Mr. McNeill Love's views on the treatment of appendicitis. His opinions are concisely expressed and clearly set out, and the book contains an Index.

The section on Differential Diagnosis contains a discussion of the more usual conditions met with in this country which may cause difficulty in diagnosis, but omits consideration of some of these tropical diseases particularly the dysenteries, which so often give Army Surgeons much trouble. He likewise does not discuss any of the more purely medical conditions seen in tropical countries, where abdominal pain as a presenting sympton often requires anxious consideration and accurate evaluation.

No Army Surgeon of experience will have any difficulty in supporting Mr. McNeill Love's plea for what he calls the "rational treatment of selected cases of Acute Appendicitis . . . ," and this excellent little book will well repay study by Medical Officers in the Army where affections of the appendix are of such frequent occurrence.

D. C. B.

Notices.

THE GOLDEN JUBILEE OF THE ROYAL ARMY MEDICAL CORPS

SUMMARY OF EVENTS

IN YOUR OWN NEIGHBOURHOOD

Travelling in these days presents many difficulties and it is for this reason that local celebrations are being arranged by branches of the R.A.M.C. Association in various centres throughout the country. Notices will appear in the local press and full particulars can be obtained from any military hospital or other Army Medical Unit.

In case of doubt or difficulty you should communicate with the Regional Secretary, R.A.M.C. Association, c/o D.D.M.S. at the Headquarters (Medical) of the Command or Independent District in which you live. These are as follows: Northern Command, York; Southern, Salisbury; Eastern, Hounslow; Western, Chester; Scottish, Edinburgh; London District, Curzon Street, W.1; Northern Ireland District, Lisburn, Co. Antrim.

Commands abroad will make their own local arrangements regarding the notification of all concerned.

AT ALDERSHOT AND CROOKHAM

The following is a short summary of the events of the week:—

June 21 *and* 22

The historic cricket match between the R.A.O.C. and R.A.M.C. will be revived.

June 22 (*Evening*)

Corps Swimming Gala.

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June 23

Visit of H.M. The Queen, Colonel-in-Chief. The day's events will begin with a short religious service followed by a ceremonial parade. All spectators will be required to be in their places by 11 a.m. The remaining events of the day will be of a private nature and details, timings, etc., await Her Majesty's pleasure.

June 24

Annual Corps Sports.

The Annual Warrant Officers' and Serjeants' gathering will be revived

All Ranks' Dance.

It will be readily understood that it will not be possible to send individual notifications to all the friends we should like to have with us and it is hoped that the receipt of this circular will be regarded as a general invitation to all friends of the Corps.

It will greatly assist in making the necessary arrangements if those who wish to attend will, as early as possible, notify the Commandant, R.A.M.C. Depot and Training Establishment, Boyce Barracks, Crookham, Aldershot, giving the different events at which they wish to be present. Numbers only will be required in the case of parties of troops, Association branches, etc. Those who notify their intention of attending will be provided with further details as to times, facilities for accommodation, etc.

IN LONDON

June 25

Annual Corps "At Home" at Millbank and Corps Dinner or Buffet Supper at the Connaught Rooms.

June 26

A GREAT JUBILEE RALLY will be held in the CENTRAL HALL, WESTMINSTER, in aid of the R.A.M.C. War Memorial Fund.

The full band, bugles and choir of the Corps will recall musical memories of fifty years. Miss JANET HAMILTON-SMITH and Mr. JOHN HARGREAVES will give vocal items.

Commentator: Mr. FREDERICK GRISEWOOD.

6.30 *p.m.*

Dr. G. F. BROCKLESS, MUS.D., F.R.C.O., A.R.C.M., L.R.A.M., at the organ.

6.45 *p.m.*

Introductory talk, Mr. GRISEWOOD.

7.0 p.m.

Opening address by the DIRECTOR-GENERAL. Short addresses will also be given during the evening by GENERAL SIR WILLIAM SLIM, *G.B.E., K.C.B., D.S.O., M.C.,* GENERAL SIR JAMES STEELE, *K.B.E., C.B., D.S.O., M.C.*, Adjutant-General, and COLONEL SIR ALFRED WEBB-JOHNSON, BART., *K.C.V.O., C.B.E., D.S.O., T.D.,* President, Royal College of Surgeons.

Prices of seats: 7/6, 5/-, 3/6, 2/-.

Light refreshments will be available at the Central Hall from 6.0 p.m.

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It is hoped that members of the new Territorial Army and Old Comrades (men and women) of two wars will make a rendezvous at the Rally.

All entitled to do so are invited to wear uniform or, alternatively, medals, miniatures or ribbons.

A cordial welcome is extended to families and friends.

THE JUBILEE SCRAPBOOK (*To be published early in June*).

This is a souvenir volume for all ranks past and present and for all friends of the Corps. It opens with a special Jubilee message from H.M. The Queen, our Colonel-in-Chief, together with a new portrait. This is followed by tributes from the Secretary of State, the Chief of the Imperial General Staff, the Adjutant-General, the leaders of the civil medical profession, the Directors-General of the Medical Services of our Allies and Dominions, and others. It contains articles of historical and general interest such as life in the ranks fifty years ago, the story of R.A.M.C. sports and games by Lieut.-Colonel Prince, early days with the Volunteers and Territorials, and many others. It is profusely illustrated with photographs of great events in our history.

Please order your copy as early as possible. Individual copies should be obtained direct from Messrs. Gale & Polden. Demands for copies in bulk should be forwarded by units to the Secretary, R.A.M.C. Association, 84, Eccleston Square, S.W.1.

All profits in aid of the R.A.M.C. War Memorial Fund.

Further information can be obtained from:

HON. SECRETARY, R.A.M.C. JUBILEE COMMITTEE,
c/o R.A.M.C. ASSOCIATION,
84, ECCLESTON SQUARE, LONDON, S.W.1.

R.A.M.C. GUILD AND COMFORTS FUND

IT is notified that this Fund with the approval of Her Majesty The Queen, our Colonel-in-Chief, has now ceased its activities. The generous support it has received during the past eight years has enabled it to carry on its work on the scale necessary to meet all demands from all parts of the world. The balance of the fund has been handed over to the R.A.M.C. Memorial Fund.

DULCIE HOOD,
President R.A.M.C. Guild and Comforts Fund.
April 1, 1948.

THE CORPS NEWS AND GAZETTE

COMMENCING in October 1948 the *Corps News and Gazette* will appear in a new form published separately from the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS. The title suggested is "*The Army Medical Services' Gazette*," but the managing committee will welcome suggestions as to alternative titles.

The new publication will be non-technical, confining itself to general news

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on the lines of similar Regimental Journals. It will be divided into sections recording news from the following:

R.A.M.C. stations at Home and abroad with items of general interest to all ranks, both of the Regular Forces and the Territorial Army Medical Corps, The Royal Army Dental Corps, The Queen Alexandra Military Nursing Service and The Associated T.A. Nursing Service, and The Royal Army Medical Corps Association.

Representatives at Home and Overseas will be responsible for the collection and submission of news items.

To commence with, it will appear Quarterly, but it is hoped, indeed anticipated, that it will prove sufficiently successful and in such demand that monthly publication will be possible. This will enable the Editorial Staff to keep up to date with current events. The success of this new publication will depend largely on the interest taken by potential contributors.

The format of the Title Page (front cover) of the new venture is not yet decided. From sample designs the favourite has a narrow cherry-coloured margin with, at the top, the badges of the R.A.M.C., the R.A.D.C., and the Q.A.I.M.N.S.—within the border is the title in Old English lettering above a photograph of the stretcher-bearer statuette in the R.A.M.C. Headquarter Mess.

Suggestions as to alternative titles and design will be gratefully received.

The Journal of the Royal Army Medical Corps will remain a Technical and Professional journal but there will be close co-operation between the two Editorial Staffs and articles of general interest will continue to appear in the *Journal*.

The Editor of the *Journal* is anxious to receive articles, not only from serving and retired Regular officers but, also, from officers of the Territorial Army, the officers of the R.A.D.C. and from officers of the Q.A.I.M.N.S. The constitution of the *Journal* specifically excludes controversial correspondence but letters containing constructive criticism are always welcome.

ERRATA

"The Treatment of Acute Uncomplicated Gonorrhœa in the Male by means of a Single Intramuscular Injection of Oily Penicillin B.P." (Eames and McClay).

Journal of the Royal Army Medical Corps, February, 1948, No. 2, page 67, Table I, column 6: The figure *should read* 9* *not* 5*.

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EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, personal experiences, etc.

Correspondence on matter of interest to the Corps, and articles of a non-scientific character, may be accepted for publication under a *nom de plume*.

All Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the author notifies at the time of submission that he reserves the copyright of the article to himself) become the property of the Library and Journal Committee who will exercise full copyright powers concerning such Articles.

A free issue of twelve reprints will be made to contributors of Original Communications, and of twelve excerpts in the case of Lectures, Travels, Clinical and Other Notes. Such free reprints or excerpts will, however, owing to the shortage of paper, only be sent to those specifying their wish to have them, and a request for them should accompany the article when submitted for publication, the request being made in the form of a note at the foot of the manuscript.

Reprints or excerpts, additional to the above, can be furnished on payment if specially ordered at the time of submission of the article for publication.

Communications in regard to editorial business should be addressed—"The Editor, Journal of the Royal Army Medical Corps, A.M.D.2, War Office, London, S.W.1."

MANAGER'S NOTICES.

The Annual Subscription for the Journal of the Royal Army Medical Corps is £1 payable in advance. Single copies, 2s. 6d. per copy.

Cheques, etc., should be made payable to the "Journal R.A.M.C.," and crossed "Holt & Co."

Communications in regard to subscriptions, change of address, etc., should be addressed "The Manager, Journal of the Royal Army Medical Corps, A.M.D.1, War Office, London, S.W.1."

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ISSUED MONTHLY

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Journal
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SURGEON GENERAL JAMES JAMESON, *C.B.*

The First Director-General of the Royal Army Medical Corps.

JAMES JAMESON was born at Kilbirnie, Ayrshire, on August 15, 1837. He took his M.D.Glasgow in 1865.

He was appointed an Assistant Surgeon on November 9, 1857, and was posted to the 47th Foot on April 17, 1862. He was promoted to Staff Surgeon on May 18, 1870, as a recognition of his highly meritorious service during the epidemic of yellow fever at Trinidad.

He became Surgeon Major A.M.D., May 18, 1870; Brigade Surgeon May 2, 1883; then Surgeon Major-General; afterwards Surgeon General on July 6, 1893, and Director-General 1896.

He was a Knight of Grace, Order of St. John (1896), *C.B.* (Civil) 1897, and Q.H.S. October 1897.

His tour of office as Director-General was associated with the early part of the South African War (1899–1901) and with the foundation of the Royal Army Medical Corps. He retired on June 1, 1901, and died, at Eltham, on September 13, 1904.

His services were recognized by the following Honorary Degrees: LL.D.Glasgow; M.D.Dublin; F.R.C.S.Eng.; and F.R.P.S.

He saw service with the operations in connexion with the Fenian Raid in Canada in 1866, being awarded the Medal with Clasp. In the Franco-German war he served with the British Ambulance

Director-General JAMES JAMESON, *C.B.*
Director-General Army Medical Department 1896-1901

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at the Siege of Paris and during the campaign on the Loire. He was awarded the Memorial Medal of William I.

On his retirement he was given a Complimentary Dinner by the Medical Profession in London as a token of the high esteem in which he was held by the Profession as a whole.

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FAREWELL MESSAGE FROM LIEUTENANT-GENERAL SIR ALEXANDER HOOD.

Late Director-General Army Medical Services.

On relinquishing my appointment, I wish to thank every one of you who served with me during my period as Director-General, for the loyal and devoted manner in which you carried out your duties.

In War and in Peace, at home and abroad, under difficult and dangerous circumstances, you have given of your best, and in doing so you have earned the gratitude of the Army and the Nation.

You have every right to be proud of the immediate past, if on that pride you base determination to carry the same high ideals of service into the future.

Ours is a heavy responsibility—the care of the health of the British Soldier.

Unlike the rest of the Army, we are always operational, the enemy is always active, held at bay, never entirely defeated.

Our task demands constant study, vigilance, determination and self-sacrifice, and the rewards lie in the achievement of something so well worthy of our efforts.

In my visits to many medical units all over the world, I have spoken to thousands of you and have stressed the fact that it is as a team we work and as a team we succeed, the strength of the team is its combined performance, the importance of your work lies not in itself but in its ultimate effect on the team's results.

Therefore, every member of our team must pull his full weight, otherwise our results will not be as good as they might be and our charge — the British Soldier — will suffer.

The standard set in the past has been a high one, and I am confident that the Medical Services will progress to greater efficiency than ever in the future.

Alex Hood,
Lieut.-General,
Director-General, Army Medical Services.

The War Office.
23 *March* 1948.

Lt.-General Sir A. Hood,
Late Director-General, Army Medical Services.

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AN APPRECIATION

LT.-GEN. SIR ALEXANDER HOOD, *G.B.E.*, *K.C.B.*, M.D., F.R.C.S., F.R.C.P., LL.D., K.H.P.

Alexander Hood was born in Leith near Edinburgh on the twenty-fifth of September, 1888. He was educated at George Watson's College and Edinburgh University, graduating M.B., Ch.B. in 1910. After a year as House Surgeon in Edinburgh Royal Infirmary and in general practice in Edinburgh and Perthshire, he entered the Royal Army Medical Corps by competitive examination.

He was commissioned Lieutenant R.A.M.C. on 26th January, 1912, and won the Marshal Webb Medal and prize for Military Medical Administration at the first Junior Course at the Royal Army Medical College. After short periods in the Military Hospitals at Lichfield and Ripon, he sailed for India on 11th February, 1914. Service in Rawalpindi and Agra was cut short by the outbreak of war, whereupon he left for France with the 3rd (Meerut) British General Hospital. Promoted Captain on 30th March, 1915, he served with his hospital at Orleans and Rouen and was for a time a temporary surgical specialist.

He left France early in 1916 and returned to India, where he served for the next five years on the North West Frontier. He commanded successively various station hospitals, a convalescent section and a section of a Motor Ambulance Convoy. At this time Hood gained valuable experience in outbreaks of cholera, smallpox and plague. He received a letter of thanks from the G.O.C. Northern Command for his part in the control of an outbreak of plague.

On the 1st October, 1918 he was appointed D.A.D.M.S. (Mobilization) 2nd Rawalpindi Division and was promoted Temporary Major.

In November of the same year he married Miss Evelyn Dulcie Ellwood. A son was born in 1919 and two daughters in 1923 and 1926.

He came home from India in March 1921 and, after a few months at Woolwich and Shorncliffe, joined the R.A.M. College for the Senior Course. This he passed with 80·4% marks and Distinctions in Pathology and Medicine. He passed on to the Specialist course in which he gained 72·5% marks in Pathology and was graded as a Specialist in that subject.

Then followed two years as D.A.D.P. at H.Q. Rhine Army, during which he acquired considerable medico-legal experience.

In November 1924 he returned once more to India and was Specialist in Pathology at Meerut and Bangalore, later becoming D.A.D.P. Madras District. At this time he was working on the manufacture of antigens for the Kahn test.

In 1928 he was awarded the Parkes Memorial Prize and Gold Medal for his Essay on "Bacillary Dysentery, its means of spread and method of control."

He was appointed A.D.P. Southern Command India in January 1929 and held the appointment for nearly two years before returning home to become A.D.P. Southern Command and Officer-in-Charge of the Leishman Laboratory.

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During this period Hood did much work on cerebro-spinal fever, including the typing of meningococci, and on blood grouping and transfusion.

In 1931 he graduated M.D. Edinburgh with Tropical Medicine as a special subject and a thesis on Bacillary Dysentery.

After attending the Senior Officers' School in 1933, he was posted to Egypt and held successively the appointments of Senior Medical Officer Sudan, A.D.P. Egypt and S.M.O. Canal Zone, during which last appointment he was a member of the Malaria Commission of Egypt.

On 1st May 1934 he was promoted Lieutenant-Colonel. He moved to Palestine in February 1937 as A.D.M.S., and later D.D.M.S. British Troops in Palestine.

While in Palestine Lt.-Col. Hood was promoted Brevet Colonel on 1st July, 1938, Colonel on 20th June, 1939, was awarded the C.B.E., and was mentioned in Despatches.

He returned home in 1939 and commanded the Queen Alexandra Military Hospital, Millbank for a few weeks before taking up his mobilization appointment as D.D.M.S. British Expeditionary Force. While in France he was responsible for much of the medical planning of the B.E.F. and was twice mentioned in Despatches. On his return, after a few months as D.D.M.S. Scottish Command and Deputy Director-General at the War Office, Brigadier Hood was appointed Director-General and promoted Lieutenant-General on 1st August, 1941.

For the next six and a half years General Hood was responsible for the organization and administration of the medical, dental and nursing services throughout the world. This involved the medical planning for campaigns in all theatres, their maintenance in medical, dental and nursing personnel, transport and equipment, and the transport of sick and wounded by air, sea and rail between all theatres and the United Kingdom. At the period of peak expansion the administration of personnel included some 13,000 doctors, 2,100 dentists, 10,000 nurses and 150,000 men. A complete re-organization of the medical services in the field was carried out; the Field Dressing Station and a considerable number of small specialist teams were introduced; existing units were adapted and new ones evolved to operate with airborne troops and in assault landings.

During the war General Hood visited all theatres and most parts of the world where British troops were serving. Between November 1942 and February 1943 he toured West Africa, Middle East, India and Gibraltar. While in India he was a member of the Medical Mission which assisted at the birth of the Indian Army Medical Corps. Between September and November 1943 he visited America, North Africa and Italy.

In November 1944, after a visit to Brussels, he spent two months in India and South East Asia.

During 1945 he visited Paris and South Africa.

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Among the honours, awards and distinctions conferred upon General Hood during the war were the following:—

1941—Honorary Physician to the King.
F.R.C.S. Edinburgh.

1942—C.B.
Commander of the Order of St. John.

1943—K.C.B.

1944—Knight of the Order of St. John.
F.R.C.P. London.
F.R.F.P.S. Glasgow.

1945—D.C.L. Durham.
LL.D. Edinburgh.
Delivered the Harveian Oration at the Royal College of Surgeons.

1946—G.B.E.

1947—Commander of the Legion of Merit.
Commander of the Order of the Crown of Belgium.
Knight of the Order of the White Lion of Czechoslovakia.
Knight Commander of the Order of Orange Nassan.
Fellow of the Royal Society of Tropical Medicine and Hygiene.
Chairman of the Board of Governors, Star and Garter Hospital.
Governor of the London School of Tropical Medicine and Hygiene

After thirty-six years' service General Hood relinquished the appointment of Director-General on 1st April, 1948.

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Lieutenant-General N. CANTLIE
Director-General, Army Medical Services

LIEUTENANT-GENERAL N. CANTLIE, *C.B., M.C.,* F.R.C.S., K.H.P.

The Present Director-General of the Army Medical Services.

OUR Jubilee number is a landmark which stands out appropriately on such a memorable occasion.

Its comprehensive review of progress made in all branches of medicine, surgery, hygiene and pathology is of absorbing interest. The period marks roughly the span between the beginning of the South African War and the end of World War II, and here for all to read, are details of the advances made to defeat disease.

At times our Corps has been conspicuous in leading this advance, and we honour the names of Leishman and of David Bruce for earning undying fame in the mastery of tropical diseases. Let us remember, too, the conspicuous part we have played in the fields of immunology.

I am confident that we will take our rightful place in the fight against disease in the future as we have done in the past, for the professional attainments of our Corps have never been higher than they are to-day. It is encouraging to know that the number of Regular Officers under training as specialists is a record.

And so, while we look back with pride upon the part we have played in the fifty years of our existence, let us be determined that the future will prove that a high professional standard will ever be the finest aim of our Corps, and that as doctors we will provide a comprehensive Medical Service which is second to none.

N. Cantlie.

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COMPLIMENTARY

The Hospital Corps of the United States Navy celebrates its Jubilee in June 1948, the same month as our own Jubilee.

The following letters have been exchanged on this memorable occasion:

London, S.W.1.
26th January, 1948.

Dear Sir,

We wish to send you, on behalf of the Journal of the Royal Army Medical Corps, our congratulations and best wishes on the occasion of the Jubilee of the Hospital Corps of the Navy. The *Hospital Corps Quarterly* is read here with the greatest interest and with keen appreciation of the high professional standards shown in its articles.

We are celebrating the Jubilee of the Royal Army Medical Corps also in June of this year—our Journal is some five years younger. It, therefore, gives us particular pleasure to be able to send greetings to a Corps of the same age with an enviable record of high professional attainment.

Yours faithfully,
G. W. Will,
Colonel (late R.A.M.C.), Editor.

Surgeon General Clifford A. Swanson,
United States Navy,
Editor Hospital Corps Quarterly,
Navy Department,
Washington (D.C.), U.S.A.

9th March, 1948.

My Dear Colonel Will,

I am very happy to receive the congratulations and best wishes of the Journal of the Royal Army Medical Corps on the occasion of the Jubilee of the Hospital Corps of the Navy. I am also very much pleased with your statement that the *Hospital Corps Quarterly* is read with such interest and appreciation. These expressions of goodwill by our English conferees are much appreciated.

Let me reciprocate your kind wishes and compliments by sending mine and those of the Medical Corps of the Navy on the occasion of the Jubilee of the Royal Army Medical Corps which, also, has a June birthday.

With kind regards,
Sincerely yours,
C. A. Swanson,
Rear Admiral (MC),
Surgeon General, U.S. Navy.

Colonel G. W. Will, R.A.M.C., Editor,
Journal of the Royal Army Medical Corps,
The War Office,
London, S.W.1, England.

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EDITORIAL FOREWORD

It is felt seemly that, at this time of the Jubilee of the Royal Army Medical Corps, some record should be made of the progress and advances made in the Professional work of the Corps during these past fifty eventful years. While we shall never forget the work done by the Medical Services of the Army prior to 1898 it is during the subsequent fifty years that outstanding advances have been made.

During these fifty years scientific achievement has led—directly or indirectly—to the startling and alarming developments of modern warfare. At the same time there have come great advances in our knowledge of the control and treatment of disease and in our social outlook enabling us to compete with and overcome most of the more destructive horrors of war.

In this number of the Journal an attempt has been made to review—all too briefly—the professional advances made by the Corps.

One thing which stands out clearly is the very close co-operation there has always been with the Medical Profession as a whole and the way in which our officers have always been able to work with their civilian colleagues.

Always, in times of peace, have civilian doctors been willing to give instruction, help and advice. In war we have been brothers in arms and during the two World Wars there was nothing to distinguish the Regular from the Territorial and but little between them and the officer holding a temporary commission. We owe more than can be expressed in words to the various consultants and advisers who gave of their skill and energy so unstintingly.

A great deal of the medical work done in the Army has been of inestimable value to the citizens of our country. Particularly may we mention the work of our venereologists and the work of the Hygiene Department. Former officers of the Corps have occupied leading positions in civil life in the practice of these specialties. Officers experienced in tropical diseases have taken a leading part in civilian medicine and come to fill high places.

There are not many among us whose memories of medicine go back over fifty years. The great changes that have taken place are brought out very forcibly and clearly in the article on venereal diseases. The younger officers of to-day can have no conception of the type of case seen in a Venereal ward fifty years ago. This history of the treatment of venereal disease in the Army is the history of the treatment of venereal disease.

The scope and extent of this number has been limited by various factors and some subjects might well have been dealt with in greater detail while others might have been included. We should have liked an article on the transport of sick and wounded which is only referred to, here and there, *en passant*. It may be said that the advances made in transport are due to the invention of the internal combustion engine which, while enabling battles to be fought at a higher pace, also brought motor ambulances to evacuate our

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casualties rapidly and smoothly over long distances. For immediate transport the stretcher remains essential and stretcher-bearers will never be eliminated. The type of terrain dictates the type of front-line transport but the ubiquitous Jeep—the successor of the "Tin Lizzie" of the first world war—and soon the Helicopter, mean more rapid and easy transport from forward positions.

Long-range evacuation by air to Base hospitals is now a normal routine and has revolutionized many of our ideas and administrative methods. It proved itself in North-West Europe and in the Far East, where it was invaluable. It is not too much to hope that, should war unfortunately come again, we may have complete air evacuation medical units with their own planes protected by the "Red Cross." This would seem a natural development from the motor ambulance convoy. Fifty years has seen us progress from bullock tongas, horsed ambulances and many another to the modern air liner. Hospital ships will probably continue to be used.

If an officer who fought at Omdurman were asked what he considered the greatest development he might well answer, "The Parachute Field Ambulance." In those days not even the most imaginative could have envisaged these highly trained and superbly equipped medical units serenely dropping from the sky well behind the enemy lines. Their personnel were quietly spoken, self-confident, self-reliant and highly trained young men. They typify the new generation and show that we still produce men who can keep pace with the changed conditions and tempo of modern war. Their brothers in the airborne units were of the same kidney.

One great advance that has been made is in the application of psychiatry to military problems. It has long been felt that there should be a very close connexion between hygiene and psychiatry and this happy state of affairs seems likely to be realized. While the psychiatrist must never forget that he is a physician who treats the mentally ill he has also a very valuable, indeed essential, rôle as a mental hygienist. Conditions of modern life with its fears, anxieties, perplexities and uncertainties together with the increased stresses of "total war" place an increased strain on the individual. Every man has his limits of physical and mental endurance—the cracking level varies but there is a limit to what can be borne. Physicians and surgeons can do much to help in securing physical fitness but, above all, it is the rôle of the physical and mental hygienists, working together, to see that the cracking point is raised to as high a level as possible.

The Editor wishes to express his thanks to all the contributors who have given so much of their time in response to his importunity. He hopes that they who read may find at least something to both interest and profit them.

In looking back over the history of our work and endeavours in the last fifty years we may quote, with slight alteration, II Maccabees, 15, 38:

> "If we have done well, and is fitting the story, it is that which we desired; but if slenderly and meanly, it is that we could attain unto."

Somehow we feel that posterity will judge us not unfavourably.

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"WEAR WORTHILY"

A TALE OF THREE DINNERS

BY

Lieutenant-General Sir ALEXANDER HOOD, *G.B.E., K.C.B.* M.D., F.R.C.S., F.R.C.P., LL.D.

A London Victorian "season" was commencing with its round of entertainments, balls, operas, dinners, and in that carefree luxurious atmosphere in the spring of 1898, to a banquet at the Mansion House were bidden the famous and illustrious of the medical profession of the United Kingdom. For the first time the Lord Mayor of the first city of the Empire was honouring, in the traditional fashion of the City of London, the medical profession—a notable occasion. To meet the doctors, were invited distinguished men of other callings, including several statesmen amongst them the Marquis of Lansdowne and Lord Russell of Killowen. That they were indeed deserving of all honour, is evidenced by some of the names in that great gathering. First and foremost the grave gentle Lister, the only medical peer of these days, retired from active practice full of honours, Sir Samuel Wilks, the handsome kindly President of the Royal College of Physicians, Sir William MacCormac, President of the Royal College of Surgeons, the President of the General Medical Council, bearded, grim, humorous Sir William Turner, Professor John Chiene, President of the Royal College of Surgeons, Edinburgh—honest John of the dome-like head, Clifford Albutt that most learned Regius of Cambridge, McEwan of Glasgow, Lander Brunton the "kindly Scot" of Edinburgh and Barts, Ferrier the Neurologist, and, by virtue of their office, the Medical Director-Generals of the Royal Navy and the Army, and many others.

After the loyal toast, the company settled down to listen to the speeches which are an inevitable accompaniment of such an entertainment and it is to be hoped that, having in view the occasion, they were in a receptive and attentive mood. Lord Russell of Killowen proposed the toast of the Navy, Army and Reserve Forces and this was replied to on behalf of the Royal Navy by the Medical Director-General, very briefly; for the Army the company may well have been surprised to find the reply coming from no less a person than Her Majesty's Secretary of State for War, The Marquis of Lansdowne. There must have been many of his listeners who knew in outline what he was going to announce and others had probably sensed a dramatic feeling of expectancy in the audience. After referring to the failure of Army boots in the Egyptian campaign, Lord Lansdowne passed to complimentary references to the medical profession in general and then to the Army doctor to whom he gave great credit for his whole-hearted devotion to duty in all circumstances. He discussed his grievances and his rank and suggested remedies.

He then continued:

"We have attempted several times to deal with this question of rank as it affects the Army doctors and we have not been particularly successful; we

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have invented ingenious compromises which satisfied nobody and titles, some of which would for cumbrousness and cacophony be hard to beat. We propose to make a fresh start and to form—out of the Army Medical Staff and the Medical Staff Corps—a Corps, the officers of which will bear the same military titles as the other officers of the Army."

"Her Majesty, upon whose good will towards your profession I need not dwell, has been pleased to signify her intention of bestowing upon the newly formed corps, the title of The Royal Army Medical Corps, a title which I am sure it will wear worthily."

Later in the evening, Lord Lister, in replying to the toast of the House of Lords, welcomed the new Corps in these words:

"I can but express my unbounded satisfaction to the Marquis of Lansdowne for the statement he has made in regard to the Army Medical Staff. He has cleared the way and in the future, the Army will be served by the best elements of our profession."

Thus, was announced to the world, the birth of our Corps, welcomed enthusiastically by the leaders of the profession, in the civic centre of the Empire, on an historic occasion, the stars were surely propitious, the psychology wellnight perfect.

Next day *The Times,* in a leading article, recapitulated some of the difficulties and doubts of the Army Medical Service, praised the efforts of the individual doctor and welcomed the new Corps, ending thus:

"We trust that henceforward it ought to be found possible to fill the ranks of this Branch of the Service with young men who, maintaining the ideal of devotion and courage, that has never been lowered, will work up to a higher professional standard and further a reserve of strength on which the nation can depend in time of need."

On June 23, 1898, the Royal Warrant of Queen Victoria, constituting the Corps, was published.

The Army List of July 1898 shows the old nomenclature of Army Medical Staff, with the Director-General, Army Medical Department, its Surgeon Major-Generals, Surgeon-Colonels, Brigade Surgeon Lieutenant-Colonels, and so on. and the first five officers on the list of Quartermasters have dates shown, when they were Lieutenants and Captains of orderlies. The date of birth and date of each successive step in rank is shown for every officer. The Commands had P.M.O.s and the Honorary Physicians and Honorary Surgeons to H.M. The Queen are shown in the opening pages of the List—in those days, this distinction was apparently retained for life and amongst the distinguished holders were Surgeon General Sir James Mouat, *V.C.*, one of the recipients of the Victoria Cross, in the first list of awards of this decoration who had been retired, some years before 1898.

There were 19 Companies serving in England, Scotland and Ireland, and two Companies " A " and " B " at the Depot at Aldershot. In the Army List for October 1898 the new titles are shown—the Army Medical Service with a Director-General, Army Medical Service (not Services), the Army Medical Staff

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with 11 Surgeon Generals, the Royal Army Medical Corps with Colonels, Lieutenant-Colonels, Majors, Captains, and Lieutenants. The first batch of Lieutenants in the new Corps was dated July 27, 1898, and was headed by W. H. S. Nickerson, afterwards Major-General, *V.C.*, and George S. Nickerson, who was present at the death of the Kalifa and later left the Corps to become a Civil Commissioner in the Sudan, and also two others who became Major-Generals, J. S. Gallie and C. W. Mainprise, later Commandant, Royal Army Medical College. The Army Medical School was at Netley, it had a Senate, Professors and Assistant Professors.

	Professors
Clinical and Mil. Surgery	Col. W. F. Stevenson, M.B., R.A.M.C.
Clinical and Mil. Medicine	Bde. Surg. Lt.-Col. K. McLeod, M.D., ret. I.M.S.
Military Hygiene	Col. J. L. Notter, M.D., R.A.M.C.
Pathology	Almroth Edward Wright, Esq., M.D.
	Assistant Professors
Clinical and Mil. Surgery	Maj. W. Dick, M.B., R.A.M.C.
Clinical and Mil. Medicine	Lt.-Col. W. E. Webb, M.D., R.A.M.C.
Military Hygiene	Capt. W. H. Horrocks, M.B., R.A.M.C.
Pathology	Maj. D. Semple, M.D., R.A.M.C.
Secretary	Surg. Capt. W. W. Webb, ret. I.M.S.

The Commander in Chief was Field-Marshal Viscount Wolseley and the Director-General, Army Medical Service was shown in the Army List between the Chaplain-General and the Director-General, Army Veterinary Department, with one professional assistant, and an office at 18, Victoria Street, Westminster.

The new Corps was soon in the Field, and received the thanks of the G.O.C.-in-C. Cairo, in October 1898 for its services in the Nile Campaign, then came, a year later, the South African war, the biggest war for many years, which tried the R.A.M.C. severely. The quality of its officers is attested by the six V.C.s awarded, and while there was a certain amount of criticism and a Royal Commission inquired into the care of the sick and wounded in the campaign, the conclusion of that Commission was: "And all witnesses of experience in other wars are practically unanimous in the view that, taking it all in all, in no campaign have the sick and wounded been so well looked after as they have been in this."

The twelve years between 1902 and the outbreak of war in 1914 was an important time in our Corps History, there came increased competition to enter the Corps, partly because the attractions of the sister Service, the Indian Medical Service, had diminished, so that the competitive examinations for commissions produced three or four candidates for every vacancy, and there were regular crammers in London, who prepared the newly qualified for the examination. In the 1914–18 War, the Corps enhanced its reputation greatly and another Dinner was held in London, this time in the Connaught Rooms on June 8, 1920. The hosts were headed by the Earl of Middleton, and included Lord Derby, Sir Vesey Holt, Lord Lee of Fareham, the Marquess of Salisbury, and many others. The dinner was given in "appreciation of the splendid

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services of the Royal Army Medical Corps and eminent civilians attached to it during the war."

The guest of the evening was Lieut.-General Sir Alfred Keogh, *G.C.B.*, *G.C.V.O.*, twice Director-General. There was a principal table and 19 other tables, with one host and six to eight guests at each table. The speakers at that dinner were Lord Middleton, the Rt. Hon. Winston Churchill, Field-Marshal Lord Haig, all of whom paid tribute to the work of the Corps and the eminent civilians attached to it amongst whom one notes Colonel Sir Alfred Webb-Johnson, now Chairman of the Army Medical Advisory Board. Sir Alfred Keogh, Sir John Goodwin and Sir George Makins replied.

So we had continued to wear our title worthily.

The twenty years between the two great wars, 1919–39, was an anxious period for the Corps, and eventually improved conditions following the Warren Fisher Committee, and the introduction of short-service commissions, began to produce a reasonable flow of satisfactory candidates for commissions, but the tours of service overseas remained out of all proportion. It can be said, however, that at this period the standard of professional skill and knowledge and experience was higher than ever before. Then came the war of 1939–45 and, at its end, another dinner was held; it is a commentary on our war effort that this dinner took the form of a running buffet instead of a banquet. It took place on October 14, 1946, at the Royal Society of Medicine, and there the civilian Consultants and Advisers to the Army during the war presented the R.A.M.C. with a cheque for £500 to found a prize at the R.A.M.College, and announced their intention of presenting to the Corps a bound volume of photographs of all the Consultants and Advisers; to be housed in the Headquarters' Mess at Millbank. Major-General Sir Heneage Ogilvie, in making the presentation, paid a handsome tribute to the work of the Corps in the War of 1939–45.

It is just fifty years ago since Lord Lansdowne in announcing the inauguration of the Royal Army Medical Corps predicted that its new title would be worn worthily—we can leave our claim to have done so to history in the belief that it can be summed up in the words of the inscription on the book presented by the civilian Consultants:

> "To the Headquarters Mess of the R.A.M.C. to commemorate the happy and loyal co-operation which prevailed through those momentous years between the regular and temporary officers of the Army Medical Service which assured to the British soldier, the finest medical care the fighting man has ever received in the history of war."

Yes, indeed, not only has our title been worn worthily, but the men who have served in the Corps during its first fifty years have carried out the proud boast of its motto—"IN ARDUIS FIDELIS."

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FIFTY YEARS OF HYGIENE IN THE BRITISH ARMY

BY

Brigadier A. E. RICHMOND, *C.B.E.*, K.H.S.

(Contributed by the Directorate of Hygiene at the War Office, the Hygiene Department of the Royal Army Medical College, Millbank, and the Army School of Hygiene, Mytchett.)

Half a century has witnessed great advances in military hygiene and the object of this article is to afford a picture of the progress made.

In the earliest years of the period referred to the South African campaign was fought. The extremely heavy incidence of preventible disease with much resulting inefficiency on account of sickness which occurred is common knowledge.

This state of affairs was largely due to inadequate understanding of, and attention to, the principles of military hygiene. This is evidenced, as Brigadier G. S. Parkinson, *C.B.E., D.S.O.,* who served in this war recounts, by the comparative absence of facilities for the purification of water supplies, poor standards of shelter, inadequate arrangements for field ablution, bathing and laundering, primitive methods of disposal of waste matters with the use of open trench latrines and no covering of excreta, unavailability of satisfactory methods of dealing with flies and other insects, and the comparative lack of any means by which troops could be disinfested.

The feeding of the soldier in this campaign was poor and his rations consisted mainly of bully beef, biscuits, jam, tinned vegetables, tea, sugar, flour and bread, and fresh meat was rarely seen. Field cooking arrangements were, according to modern ideas, primitive.

It is a far cry from the South African War to World War II and the improved health of the British soldier in the latter coupled with great reductions in the incidence of sickness are evidence of the success which attends the adequate application of the principles of military hygiene.

Training in hygiene and sanitation was begun in the Army Medical Services when Edmund Parkes was, at the behest of Florence Nightingale and with the influence and blessing of Mr. Spencer, appointed Professor of Hygiene in the newly formed Army Medical School in 1860. He wrote the first Manual of Military Hygiene as a book for medical officers and made the subject an important one in the curriculum of the officers of the Army Medical Staff Corps. When, however, the testing time came in the South African War it was found that while the Army Medical Officers had been taught the principles of hygiene they had neither the power nor the material to put these principles into practice. As Surgeon-General Jameson said to the Royal Commission on the work of the Medical Services in the South African War: " If sanitation had been understood not alone by our officers but by the rank and file, by the regimental officers and by commanding officers, I think it would

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have saved thousands of lives." That they had not the faintest idea of such principles was made plain by many witnesses before that commission, so, under the new young Director-General of the newly formed and powerful Royal Army Medical Corps, Lieut-General Alfred Keogh, the teaching first of all of sanitation and then of hygiene in its widest sense began.

At first it depended on the individual enthusiasm of medical officers. In 1905 an Army Manual of Sanitation, written for non-medical consumption, was published. In 1906 a school of sanitation was formed at Aldershot under the command of Lieut.-Colonel Firth. This school concentrated on the training of regimental officers and N.C.O.s in sanitation and in water duties. About this time as well, questions on sanitation appeared in all promotion examinations for officers.

So, between the South African War and the 1914-18 War, the principles of sanitation were taught to the Army as a whole and a certain amount of equipment for water purification and field sanitation enabled these principles to be put, at least partially, into practice as the occasion demanded. Between these two wars, too, ideas for the improvement of the general life of the soldier progressed considerably and resulted in better standards of accommodation, clothing and diet being provided; indeed the standards of accommodation set out in the Corps Journal of 1906 have not yet been achieved in some of the barracks still occupied in old-established military stations . During all these years certain names stand out as pioneers in military hygiene—Edmund Parkes, De Chaumont, Notter, Firth, Horrocks, Lelean, Parkinson and Richardson.

During the 1914–18 War training in sanitation assumed paramount importance and, in addition to the school at Aldershot, there were established several schools of Hygiene in Britain and one was set up at Helmieh in Egypt. The formation of Field sanitary sections under the Territorial Army filled a long realized gap in our hygiene organization. These units, staffed as they were by officers and men of experience, did excellent work in the training and supervision of hygiene in the field.

After the 1914-18 War came the complete reorganization of hygiene work in the Army. In 1919 Sir William Horrocks became the first Director of Hygiene and the first really scientific assessment of the output of energy by the soldier was carried out, with a natural corollary of a change in attitude to his training, his rations and diet, his clothing and equipment. Professor Cathcart and several officers of the Corps including Major-General (then Captain) D. T. Richardson played a large part in this basic work. The minimum value of the ration at home was based on a diet which yielded 3,500 calories. equipment was designed to cause minimum effort to the soldier carrying it and uniform was designed for maximum comfort and usefulness. All this had its marked effect on training which was based on the definition of hygiene as the science of maintaining and promoting the health of the soldier and the prevention of disease.

Meanwhile the Army School of Hygiene continued to impress the principles of Hygiene on the Army as a whole and on the medical services in particular, and to train the R.A.M.C. to take over the new units—Field Hygiene

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and Field Sanitary Sections—for their work in war. Coupled with the gradually increasing central activities of the school reference to and development of the teaching of hygiene in the Hygiene Department of the R.A.M.College, Millbank, have been great advances in methods of decentralized instruction and training in hygiene, and better methods of propaganda with special emphasis on the production of suitable films.

As a result great success has been achieved in promoting hygiene throughout the Army, and prominent among those who have acclaimed the importance of the progress made in keeping the fighting man fit and free from disease have been Mr. Winston Churchill and Field-Marshal Montgomery.

Physical training which is of such great moment in the inculcation of physical fitness in the Army has progressed apace in the last three decades and the Army School of Physical Training in particular, and the Army Corps of Physical Training in general have been responsible for the valuable progress made. Research into the subject of physical training has at the same time been assisted by the advice and supervision of specially selected specialists in hygiene who carried out much basis research work.

During the half-century under review there has been an ever-increasing appreciation of the great importance to health and efficiency of an adequate system of medical categorization.

In 1914 the declaration of war resulted in a flood of volunteers for Army service, and despite the instructions issued to practitioners concerned in regard to the physical requirements of the Army, the most diverse results were obtained and the general standard was most unsatisfactory.

In March 1915 Standing Medical Boards and in July 1915 Travelling Medical Boards, were instituted in order to attain some degree of uniformity and they were instructed to classify men as:

A—Fit for service at home or abroad.
B—Temporarily unfit for service abroad.
C—Fit for service at home only.
D—Unfit for service at home or abroad.

In December 1915 a more extensive classification of recruits was introduced which consisted of five main categories with certain sub-categories, and was coincident with the abolition of examination by civil medical practitioners and the general introduction of Recruiting Medical Boards.

Following upon the coming into force of the Military Service Act in January 1916 a further new classification became necessary and this consisted of those lettered categories which afterwards became so widely known, viz. A, B, C, D, and E. Category A comprised men fit for general service, i.e. able to march, see to shoot, hear well and stand up to active service conditions and, at the other end of the scale, Category E included men unfit for service in Categories A, B and C and not likely to be fit within six months.

Eventually the Ministry of National Service took over recruiting for the Army and Air Force and the medical boards concerned placed recruits in four numbered grades according to physical condition. When they joined the Army they were placed in military categories corresponding with those grades

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and posted to units accordingly. This system is the basis of the method of medical classification adopted in the 1939–45 War.

In February 1940 instructions were issued with a view to the better utilization of man-power within the Army and Army categories were increased and further subdivided. It was at the same time laid down in detail as to the categories of personnel which might be accepted in the various Arms.

It was realized as time passed that in many cases the medical category gave very little indication of the type of man to whom it was applied and did not include information as to his mental and emotional make up. As a result of this the Personnel Selection Procedure as now known was introduced, the object being to recommend the soldier for training in an appropriate arm for employment in it, according to his aptitude.

The wartime methods of medical categorization have now been replaced by the PULHEEMS system. Under this system stress is laid on functional capacity to work rather than on the effect of anatomical abnormalities in restricting a man's ability to work. It is generally agreed by all concerned that given a reasonably accurate functional assessment of a man's ability to work a more correct allocation to suitable employment becomes possible, and it is hoped that in future there will be very much fewer, if any, square pegs in round holes within the Services.

The system referred to is also being adopted by the Navy and the Air Force so that all three Services will be on the same basis in this connexion.

The problem of the substandard recruit must be mentioned here. It was a big one prior to the recent war and in 1936 a physical development centre for dealing with this type of individual was provided initially at Aldershot later at Canterbury. Another centre of this kind followed shortly in the Northern Command.

In the earlier stages of World War II it was obvious that a similar policy was necessary and a centre for 400 men was set up in July 1942. Ultimately we had three centres and these dealt with something like 35,000 men during the course of their existence. Of the first 4,000 who attended physical development centres approximately 81 per cent were raised in category and of these 69 per cent were brought up to category A1. Of a recent sample of 2,000 men examined it has been found that 75 per cent remain in category A1 after two years.

There is now one centre at Chester which caters only for the recruit who is a potential A1 soldier. It has a capacity of 1,800 trainees and deals with some 10,000 men annually. The length of the course is eight weeks and there is a special selection procedure at Primary Training Centres by which only those men who are really suitable for this special course are sent to attend it.

Although activities of the kind referred to are a very recent development in the half-century we are considering, they have produced invaluable results and must be regarded as a very definite step forward.

Much has been achieved since the South African War in improving shelter for the soldier whether it be in peacetime barracks, or tents or bivouacs in war. Not only too has basic accommodation been improved but ancillary accom-

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modation and amenities have also been brought into line with the standards now considered necessary for a healthy way of life.

The change is evident in the siting and design of barracks. In the olden days their location was apparently determined by the need to concentrate troops in towns in order to be able to quell civil disturbances. The barracks themselves were grim structures, too much in keeping with their unfavourable surroundings, two or three stories high, poorly lit by day and by night, with little facility for recreation and much more like prisons than homes.

In short, there was everything about these barracks to drive a man outside their walls in an effort to find amusement and diversion, even in the types of locality where available pleasures were of a sort to do harm, rather than good, to a man.

There has been a gradual evolution in the type of barracks built since the middle of last century, with improvement in design, but unfortunately we still have to occupy many of these obsolete buildings.

(*a*) Hollow square with barrack block built around a square—used before 1860.
(*b*) Pavilion type with separate buildings spread out.
(*c*) Half-battalion type with large connected buildings—built about 1900.
(*d*) Unit type.
(*e*) Cubicle type—designed to give each man a cubicle.
(*f*) Sandhurst block type—1933.
(*g*) Militia type—pavilion one story type.

We have now broken away from the old conception of barrack and lines and aim at a military camp, on the lines of a model village, on a well-chosen site in the country, not too far from the amenities of a town, with its own recreation fields, married quarters, shopping centre, church, etc. The conception aimed at is that of a pleasing, healthy self-contained community where the soldier can work and play and which will be sufficient to cater for the average tastes of the ordinary man.

Modern barracks are very carefully planned so that the relative position of one part to the other gives rise to the least inconvenience to the occupants of the camp. Consensus of opinion is in favour of a pavilion type of building as it is more attractive to look at, much lighter in every way, more saving of labour and considerably quieter than a storied edifice. It is in these respects that the Militia Barracks are an improvement of the Sandhurst Block.

It is very important that a clear separation should be made between administrative offices and living quarters as the soldier must accept the latter as his home and the aim is to make it natural and easy for him to do so.

Apart from the accommodation in brick and stone much attention has been given to the design of hutments, and also of tentage and of the lower grades of shelter, inseparable from Lines of Communication or Forward Areas in war. As a result improvements have constantly been developed.

In much the same way conspicuous progress has been made in adapting the clothing and equipment of the soldier to his comfort and efficiency.

By the end of the last century it was recognized that clothing should be

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designed more in accordance with physiological demands than for martial effect. It was realized that health, comfort, and efficiency were intimately affected by clothing and that it should protect the wearer against heat, cold, and wet, and should allow freedom of movement.

In the South African War we find these ideas put into practice and a change made from the old red coat to the Field Service dress of khaki. The results obtained more than justified the change. The soldier was clothed in a uniform adapted to the conditions under which he was serving. The following extract from an article by Lieut.-Colonel R. J. S. Simpson in the Corps Journal (1909) on Effects of Heat during the South African War shows what considered opinion thought of the change:—

"On the whole the Service dress could hardly have been improved upon; it was eminently suited to the climate. At the beginning there was a tendency to too close fitting, and the helmet was generally worn, but these two faults were eliminated very early and the felt hat in particular was found to be better suited to the climate than the helmet."

Subsequent to the South African War a special committee was formed to report on the physiological effects of food, training and clothing on the soldier. Its fourth report was rendered in 1909 and emphasized the necessity for comfort of clothing and equipment if efficiency was to be maintained. It recommended that clothing should be adapted to suit the particular conditions under which the Army might have to serve. For instance, shirt-sleeve order should be adopted where men had to work under warm conditions.

In the first World War (1914–18) the British Army took the field clothed in khaki designed with the experience learned on active service a decade and a half before, and on the research carried out between the wars.

Under the diverse conditions under which British troops had to serve during that war a great impetus was given to the provision of special clothing and equipment to meet the various needs—the range varied from shirts to sheepskin jackets, from boots to British Warms. The puttee, though much criticized, remained as an article of issue. During the period, however, the load carried by the soldier increased from 61 lb. to 80 lb. and this intolerable burden more than offset the advantages of the more comfortable clothing.

As a result of the criticisms levelled at the carriage of these very heavy weights, by men who themselves often weighed only 130 lb., research was carried out by Professor E. P. Cathcart and others into the maximum load that could, without loss of efficiency, be carried by the soldier. At the same time, the design of clothing and equipment was carefully scrutinized to see what improvement could be made from the physiological standpoint. The outcome of this work was the production of a new active service uniform in 1931 which was the forerunner of our present battle-dress. Parallel with the production of this new uniform, a new form of web equipment, meeting physiological requirements, was produced, and the load to be carried by the soldier was drastically cut down.

In the second World War the basic uniform and equipment of the British soldier proved itself to be thoroughly sound. Special types of clothing were

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designed to meet extremes of cold and heat, and the particular needs of air-borne and other special types of troops.

Much research still remains to be done and new problems are arising which are being given considerable thought and attention.

Concentration should now be given to advances made in the purification of water supplies in the field.

For many years before the end of the last century it was known that clarification and sterilization was necessary to make unsafe water fit to drink and all progress made in the past fifty years has been concerned with improved methods of applying these two basic principles in varying circumstances.

During the South African War, water was filtered by means of the Berkefeld and Pasteur Chamberlain filters which were difficult to maintain and too fragile for use on active service in the field. Sterilization was carried out by heating and boiling, and the usefulness of the apparatus devised for this purpose was limited by great weight, high fuel consumption and small output.

Thus it was almost impossible to provide the soldier with a safe water supply, and it is not surprising that the incidence of enteric fever rose to 100 per 1,000 per annum.

Sterilization by means of chemicals had been considered, but as Dewar stated in his essay on The Sanitation of Armies in the Field on Active Service (1907): "No reagent has been discovered which fulfils all the requirements, namely, rapid action as a disinfectant, moderate cost, convenience in use, portability, stability of composition and the leaving of the treated water in such a condition that it is neither unwholesome nor unpalatable."

Dewar concluded his essay with a table of twenty-four substances considered for use as water sterilizing agents. The following extract from this table is interesting, and perhaps amusing, in the light of present-day developments:

C. CHLORINE (GAS)... ...	The taste and smell remain. Transport and storage difficult.
F. IODINE (VAILLARD'S METHOD)	Sterilization complete in 10 minutes. It is claimed that smell, taste and appearance are ultimately normal.
V. CHLORINE (AS SODIUM HYPOCHLORITE) ...	Hunermann's process. Apparently not quite reliable.
W. CHLORIDE OF LIME ...	Traube's process. Unfavourably reported upon.
L. BRANDY AND WINE ...	Slow and unreliable.
B. POTASSIUM PERMANGANATE	Objectionable, since taste and colour persist.

In the decade between the South African War and World War I improved methods of water purification were elaborated at the Royal Army Medical College and at the School of Hygiene, Aldershot, and during this period the pioneer work of the late Major-General Sir William Heaton Horrocks provided the basis for real progress. Improved filters were developed, first compressed sponges and earthenware candles, then a metal reel around which layers of flannelette were wrapped; the latter was the precursor of the Cloth and Reel Filter which was used successfully throughout World War I and in some theatres in World War II.

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Research at the Royal Army Medical College was carried out on the sterilization of water with chloride of lime, and by the summer of 1914 the Mark V watercart was ready for trials; in this cart water was clarified by the cloth and reel filter and sterilized with residual chlorine one part per million.

Early in World War I the Horrocks Test was introduced; a little later came individual methods using tablets of acid sulphate of soda and oil of lemon which were issued to cavalry units. In 1915 the Poisons Test Case and methods of removing poisons from water were introduced.

The process of chloramination was developed between World Wars I and II, and it is used to-day in the Mark III Mobile Water Purifier which has a capacity of 3,000 gallons per hour.

Other forms of mobile purifiers, including power driven filtration were also developed with capacities ranging from 400 to 4,000 gallons per hour and Stellar and Meta-filter candles with kieselguhr powder instead of cloth and reel.

For greater speed of sterilization superchlorination was later devised, and gross chlorination was introduced to cover circumstances in which the Horrocks' Test could not be applied.

With modern warfare came the need for efficient apparatus for use by individuals and small parties; to meet this need the individual sterilizing outfit, Millbank Bag, the pannier packed transportable filter and the Midget Stirrup Pump Filter were produced.

Thus, the soldier of to-day can be assured of a safe water supply, whether he is working alone or in a large unit. It is pertinent to mention here the great contribution made to this desirable state of affairs by Major Stanley Elliott, *O.B.E.*, who for many years has worked on this subject at the R.A.M.College, Millbank.

Research and development in water purification is co-ordinated by an Inter-Services Advisory Panel on the purification of water supplies in the Field.

There has been a revolutionary change in the feeding of the soldier during the last fifty years, a change which has been vastly influenced by the increased understanding of the importance of the diet as a factor in the health of the soldier.

After the South African War it was realized that it was necessary to do more than give the soldier ¾ lb. of meat and 1 lb. of bread per day, with a cash allowance of 3d. to enable Company Commanders to purchase the other items of the diet. It was realized too that the use of the barrack room, where the soldier slept, as a place to feed in, was a deplorable custom, also that food was so badly cooked in many units that men, being unable to eat their rations, relied on beer, cheese and pickles for their sustenance.

In 1909 the first research was done into the nutritional requirements of the marching soldier. This was the first effort to replace the empirical method of assessing the diet of the soldier by estimating his energy requirements.

By 1941 the ration, in theory, gave a diet of approximately 4,500 calories but the description of outbreaks of beriberi and the references to scurvy in the reports on the health of the British Army overseas in 1913 show that there was still a long way to travel.

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The horrors of Mesopotamia and Gallipoli with the incidence of beriberi and scurvy in these areas during the 1914–18 War called for drastic action and brilliant work was carried out in the R.A.M.College at Millbank. Professor Starling became Lieut.-Colonel Starling and directed the Hygiene Laboratory at the College; with him he brought Captain Plimmer whose brilliant and painstaking work in the analysis of foodstuffs was carried out in the same laboratory. Miss Chick and Miss Hume at the Lister Institute carried out their pioneer work on B_1 and the antiscorbutic properties of various foods. These workers in collaboration with the R.A.M.College produced a satisfactory formula for marmite which was then issued to troops overseas. An efficient method for the preserving of the antiscorbutic properties of lemon juice was also discovered by these workers.

Immediately after the 1914–18 War research into the energy expenditure of the soldier was begun in earnest by Professor Cathcart of Glasgow who took under his wing as assistants many officers of the Corps, notably Captain D. T. Richardson and Captain W. Campbell. At last dietetic requirements were based on adequate scientific data! With this change in the quality, quantity, and proportions of the food issued came the newer knowledge of vitamin requirements and that knowledge was diligently applied.

The cooking and serving of the soldier's diet progressed just as quickly. In the early 1920s the first Inspector of Army Catering was appointed (Major R. G. Leggatt a former officer of the Corps) and under his guidance the ration of the soldier was adequately cooked, attractively served and, consequently, was fully consumed.

The success of these efforts was shown in the report on the Health of the Army for 1934 where it is stated that the average gain in the weight of Army recruits during the period of training at their Depots was 9 lb. As the recruits came from a population where lack of employment was rife and under-nourishment common, it was a great achievement.

Ample evidence of the sound work done in the inter-war years is shown by the universally excellent diet which was provided in the late war, for troops in all theatres under most varied circumstances and climates. Praise was given by all ranks for the way in which an ample and varied ration was always forthcoming wherever they might be.

That the food provided was physiologically adequate was manifested by the almost complete absence of nutritional deficiencies during this period.

Shortages of world food and difficulties in the distribution now present the hygienist with the problem of making the best use of such items of such food as can be made available for the soldier's diet.

Disinfection may be dismissed in a very few words as there have been no revolutionary advances in this sphere during the last fifty years.

In the South African War disinfection was carried out by means of steam; and chemicals, including carbolic acid and lime, were used to a limited extent; similar methods of disinfection are used to-day, and although more efficient steam disinfectors and improved chemical disinfectants have been introduced there have been no radical changes.

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However, in the sphere of disinfestation great changes have occurred and the advances of recent years have been revolutionary.

During the period of the South African War the word "disinfestation" does not appear to have been used, neither does the practice of disinfestation appear to have been in vogue to any material extent. Fortunately, climatic conditions were unfavourable to the spread of typhus fever and other louse-borne diseases.

World War I presented a different set of circumstances to menace the health of the soldier, and one of the most important of these was the ever-present danger of louse-infestation and the resultant diseases.

Typhus ravaged the Serbian Army in 1914 and caused 25 per cent of that Army to perish; the Allied Armies were riddled with lice, and trench fever was an important and common casualty producer. Thus the problem of disinfesting whole divisions arose—men, their clothing and their bedding.

Many disinfestors which could be improvised with comparative ease were invented; Lieut.-Colonel G. E. F. Stammers, R.A.M.C., devised the "Serbian Barrel Disinfestor," and Lieut.-Colonel Lelean the "Sack Disinfestor."

Hot-air apparatus was used extensively, including "Orr's Hut" and the "Russian Pit."

Disinfestation *en masse* required the setting up of special centres involving considerable expenditure of personnel and equipment, and in addition to disinfestation of clothing and bedding, the cleansing of the man himself necessitated facilities for bathing, haircutting, dressing and drying.

In hospitals the disinfesting apparatus used was similar, although heavier in type, to that used for disinfection in the South African War; lighter types were developed for mounting on wheels for horse transport or steam lorries.

The name of Thresh will long be associated with this period.

At the outbreak of World War II the position with regard to disinfestation was much the same as it was at the end of World War I.

Until 1944 the Millbank Hot Air Disinfestor, the "T.O.T." and the Field Portable No. 3 combined with the use of mobile bath units were the chief methods of dealing with infested troops.

With the re-discovery of DDT a complete change in the picture occurred. Elaborate disinfestation centres, heavy steam and hot-air apparatus and the like disappeared, as it were, in the twinkling of an eye, and were replaced by tins of AL 63 Mk. III which the soldier could carry in his trouser pocket.

Having been passed rapidly through laboratory and field trials DDT was pressed into service with speed, so that it arrived on the scene in time to assist in dealing with the typhus epidemic at Naples in 1944.

Methods of impregnating clothing with DDT were later devised, so that troops who took part in the invasion of Europe were better protected against louse-borne diseases than any army in history. The result was that not one British soldier died of epidemic typhus in Europe, in spite of the high incidence in places such as Belsen where the inmates were dying from the disease at the rate of hundreds per day.

With DDT the disinfestation of Ps.o.W. and displaced persons became a

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relatively simple matter, and three men with a mechanically operated dust-gun could disinfest 120 persons per hour.

DDT has dismissed as a health hazard lice, fleas and bed-bugs along with a host of other arthropods of medical importance.

New uses and methods of application of this and other similar insecticides are still being devised, and the long-term implications have yet to be fully appreciated.

Turning now to progress in regard to facilities for bathing, ablution and laundering in the field, the soldier of to-day is in a far better position to maintain a high standard of personal cleanliness than was his predecessor of fifty years ago, and the provision of facilities for ablutions and laundering has kept pace with advances made in the sphere of health education.

Fifty years ago mobile laundry and bath units were unknown; static Army laundries were all too few and were mostly limited to serving hospitals.

World War I brought with it many problems concerning ablutions and laundering; men often wore the same clothes for many days and nights on end, and hot water for ablutions was usually a luxury.

In many formations nearly everyone became louse-infested.

Accordingly "disinfestation centres" were established, so that men returning from "the line" could be given a bath, haircut and change of clean clothing. Some attempt at mobility was made by establishing these centres in railway trains, and in the years 1917–18 something resembling the mobile laundry as we know it to-day was produced.

In spite of these efforts the soldier of World War I found it no easy matter to keep really clean in person and clothing.

In World War II a very different state of affairs pertained.

Early in 1940 mobile laundry units took their place in the Field and mobile bath units, and combined laundry and bath units soon followed.

Large static military laundries were established in Base areas and on the L. of C. and performed invaluable service.

Wherever therefore the soldier had to serve facilities were provided to assist him in keeping personally clean. Admittedly, in the stress of modern war these arrangements were not always ideal, but advances had been made.

At the present time, the R.A.O.C. maintains ample installations to cater for the soldiers' needs regarding laundering in places where contracts cannot be made with civil laundries.

Static laundries are established in most theatres; improved types of mobile laundry and bath units have been evolved, so that now we have a unit which can meet the laundry and bath requirements of 18,000 troops weekly.

Soon it is hoped to see air-transportable laundry and bath units so that, in future operations, the soldier will receive closer support in this important personal matter than he has ever had before.

A small type of mobile bath apparatus for unit use has in fact been recently developed.

In times of peace, ablution facilities are limited by the availability of hot water, wash-basins, baths, soap and towels and the latter two items are limited

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in accordance with economic requirements of these austere times. The scales of wash-basins and baths have however been increased recently, and, at long last, *hot* ablution water is now regarded as a necessity for the soldier instead of a mere luxury.

In war, as distinct from peace, the Army becomes on the whole responsible for its own sanitation and cannot depend upon the good offices of Local Government and other authorities to deal on its behalf with the innumerable problems arising in connexion with the disposal of waste matters.

The difficulties in this respect which have beset military hygienists in the past are well summed up in the following extract from the Report of the Royal Commission on the South African War: "Regarding hygiene and sanitation, Tommy doesn't understand it and his officer regards it as just a fad."

Much loss of man-power was attributable to primitive methods of waste disposal, especially human excrement.

Open trench latrines, with squatting poles, were a common sight; established urinals were not in evidence.

Refuse was dumped promiscuously around camps, and animal carcasses were staked to the ground and left to decompose. At this stage, although military hygienists deplored these conditions the practice in units was to leave such matters to "bad drills and cripples of a battalion who were considered good enough for the privies and middens of the insanitary past."

The period 1914 to 1939 witnessed a rapid advance in methods of waste disposal. Standard types of latrines were used in World War I, and flyproofing was stressed; in addition, standard appliances for refuse and sullage disposal became part of unit equipment (Horsfall, Bailleul and C.I. incinerators, fæces destructors, and grease traps).

Experience gained in many different theatres in World War II has resulted in further improvements in our methods of waste disposal.

It is probably in connexion with the prevention of insect-borne diseases, particularly malaria, that the most spectacular advances of recent years have been made, and it is hardly necessary to emphasize the great achievements of the war years. It suffices to say that, with the development of DDT and similar insecticides, improvements in methods of spraying and in equipment for personal protection including repellents, and with the introduction of suppressive mepacrine it is now possible to employ a force in the most highly malarious area in the world with every confidence that the casualty rate from malaria can be kept within very low limits, provided the discipline of the force from the point of view of hygiene is good.

Sandfly fever, dengue, and other insect-borne diseases may also now be regarded as having been brought under control by the new methods now available.

Considerations of space do not permit of further details, but methods of prevention of scrub typhus which have been so successfully developed, as also the modern conception of the correct manner in which to tackle the problem of venereal disease, must not be overlooked.

In order to assess the impact of advances in hygiene and preventive medicine

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during the past fifty years on morbidity rates, it would be necessary to compare situations which are identical in all relevant respects save that of date. This would be difficult enough for a civil population. For an Army, which is by its very nature subject to considerable changes of location, living conditions, age-composition and other relevant circumstances, the path is beset with pitfalls.

Nevertheless, as far as the three major wars of the last half-century are concerned one very striking fact emerges from a survey of such information as is available.

During the South African War, the *Enteric Fever group* was responsible for an average incidence of more than 100 per 1,000 strength per year among British troops (representing 1 in 7 of all hospital admissions); in World War I it accounted for an average annual rate of 7 per 1,000 in Egypt and Palestine (1916–18) and of 1·4 per 1,000 in France and Flanders (1914–18); in World War II the average annual incidence was less than 1 per 1,000 in all active theatres. Such a dramatic decline reinforced as it is by figures for the peace years, is most unlikely to be vitiated by the circumstances enumerated above.

For a better assessment of long-term trends, it is undoubtedly more profitable to direct our attention to the comparatively static conditions of peace, where we can deal separately with certain reasonably well-defined geographical areas. Even here, comparison between different years is liable to be to some extent misleading since the composition of the population at risk may change radically and other vitiating factors may be operative.

A survey of major diseases in the United Kingdom and in two reasonably comparable Commands—India and the Middle East—in the years given in the table below brings to light certain broad trends which are sufficiently striking to merit confidence.

Incidence of Certain Diseases per 1,000 Strength among British Troops: 1897-1947.

	U.K.		*India*		*Middle East*	
	Enteric fever	*V.D.*	*Malaria*	*V.D.*	*Enteric fever*	*V.D.*
1897	31·8	127·5	364·1	422·5	6·7	161.2
1902	16·7	110·1	253·8	209·6	18·4	103·5
1907	13·1	71·9	153·8	89·9	5·3	161·4
1912	2·7	56·4	82·4	55·5	9·4	110·7
1917	—	—	—	—	—	—
1922	3·0	35·4	175·4	84·7	1·9	113·4
1927	3·0	21·4	138·8	56·8	0·7	60.5
1932	3·4	11·2	84·1	37·7	1·4	41·9
1937	0·8	12·8	44·5	40·4	0·9	44·2
1942	—	—	—	—	—	—
1947	0·7*	21·3	17·2	69·2	2·5	19·6

*Relates to 1945.

Turning attention to the figures for the average Constantly Sick per 1,000

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of strength the reduction between 1897 and 1947 is very marked as the following table shows:—

	U.K.	*India*	*Middle East*
1897	38·0	101·4	54·6
1947	27·7	28·7*	15·5

*Rate for 1937

The comparatively small reduction in the U.K. is partly attributable to the Long Term Treatment Scheme and to the evacuation of long-term cases from overseas to home hospitals.

It is, finally, interesting to compare the total hospital admission rates per 1,000 of strength in 1921 and 1947 in the Commands mentioned below, particularly as 1947 stands in relation to World War II is much the same situation as 1921 in regard to World War I, and to observe the very much lower figures in the later year.

	U.K.	*Germany*	*Middle East*
1921	434·5	691·0 (1)	741·8 (3)
1947	226·4*	439·7 (2)*	364·0*

*These figures should in the absence of final corrected figures for the year be regarded as approximate only.

(1) Rhine and Silesia. (2) British Zone, B.A.O.R. (3) Egypt and Palestine only.

It is regrettable that comparisons of a more statistically accurate nature cannot be made, but there can be little doubt that morbidity rates in the Army have become increasingly and materially lower as the application of the principles of military hygiene has improved and our knowledge of the subject has increased.

Limitations of space dictate an end to this review of hygiene in the British Army during the past fifty years.

Perhaps, however, enough has been said to afford an indication of the progress made.

Preventable disease is still too great a factor in the filling of our hospital beds and no relaxation of effort in the prevention of disease and in improving the methods by which we try to encompass this can possibly be afforded.

The increased tempo of modern warfare, however, and the much greater complexity of methods of waging war, as also of weapons, equipment, vehicles and military *matériel* of all kinds entail higher degrees of mental and physical health in the soldier than has ever been the case before. Under such circumstances more attention must be directed to the study of health as compared with that of disease.

The main objective of hygiene—*mens sana in corpore sano*—remains the same as ever, and it is to the attainment of this end that our efforts in the Army must be directed to the fullest possible extent.

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LANDMARKS IN FIFTY YEARS OF MEDICINE IN THE ARMY

BY

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The greatest contributions we, as a Corps, have made to the practice of medicine have been in the realm of prevention of disease. In the diagnostic and therapeutic aspects of military medicine the methods accepted in civil life are to a large extent equally applicable, and in the expanded Army Medical Service of wartime, practitioners and consultants from civil life become their main exponents. With the pathologists they show the nature of the problem rendered acute by war or newly brought to light by it. Their co-operative inquiries at the bedside and in the laboratory lead to administrative action for prevention of disease. The care of health under conditions of campaigning and service abroad has always presented problems fundamental to success in war and therefore calling for the utmost vigour and effort directed to their solution. In the resulting action the interest of physician, pathologist and hygienist tend to merge, and the records of war medicine show an increasing tendency to such fusion. When we pause at this stage in our history to survey what we can claim to have given to the practice of medicine during the past fifty years we shall find that our main contributions have been in the improvement of health and the prevention of disease. This is well exemplified when we review the incidence during the first world war of those diseases which had been the scourges of previous campaigns—dysentery, malaria, enteric, smallpox and typhus. We find that the last two were practically non-existent and that enteric was much less prevalent than in any previous war. A large measure of control over dysentery and malaria was deferred until the second world war, during which it was achieved.

When we review the work of our Corps in the field of clinical medicine from the time of its inception fifty years ago to the present day we find that its main achievements have been won in war. The war in South Africa (1899-1902) with a sickness rate of 958 per 1,000 found the young Service with an organization and personnel quite inadequate to meet the situation. Had more been known of the methods of infection in the diseases with which our armies were beset, much more might have been done. The clinician at that time built on a foundation of morbid anatomy, and advances in clinical medicine awaited a widening of the scope of pathology. The age of chemotherapy had not yet come; not until ten years later did the work of Ehrlich usher it in. If we exclude the researches of Leishman into the pathogenesis of kala azar, those of Bruce and Nabbaro into trypanosomiasis and of Bruce and Zammit into *melitensis* infections we find no original contribution of fundamental importance to clinical medicine in the records of British military medicine between 1898 and 1914, although continuous clinical studies into the diagnostic and therapeutic aspect of tropical diseases were being placed on record. Experience

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gained, however, pointed out the need for a more elaborate organization in war, and the scope of pathology, widened by the growth of bacteriology, hæmatology, biochemistry and other branches, opened up vistas of clinical research for which ample opportunities were to be at hand.

As the first world war began to drag on its course in the trenches of France and Flanders, problems of depletion of fighting strength by a high sick rate soon presented themselves. Four conditions, one new to the annals of military medicine, the others barely mentioned therein, attracted much attention in France. The first, to which the name "trench fever" was later given, was encountered from 1915 onwards. The infective nature of this condition was demonstrated in 1916 by the inoculation of volunteers, and in 1917 and 1918 the mode of infection and the part played by the body louse in the dissemination of the causal virus were shown in a combined research by members of the Army Medical Services and an American committee. Careful analysis of causes of sickness indicated that the condition accounted for the bulk of the large numbers of cases returned as "pyrexia of uncertain origin" and for many labelled myalgia and rheumatism. The important work centred round it merges with the wider triumph of control of disease due to personal uncleanliness and verminous infestation which forms an outstanding feature of what we achieved in France during the first world war. The other conditions referred to were trench foot, nephritis and gas gangrene, the last named essentially the concern of the surgeons. The condition called "trench foot" presented a problem unsolved up to that time, and was the subject of careful study to which investigations conducted by the Medical Research Committee were contributed. Its close relationship to true frost-bite was shown, and its incidence was reduced by the use of long, loose thigh boots, precautions taken to avoid interference with the circulation, and structural improvements in the trenches. The other subject which attracted much attention was nephritis, the association of which with conditions of campaigning had been previously noted in the American Civil War. Although nothing of outstanding importance was added to our knowledge of its prevention or cure, important observations on the presence of albumen in the urine in otherwise healthy soldiers formed a sound foundation for its assessment, and were a contribution of enduring value to medicine. It was shown that this so-called functional albuminuria did not operate as a predisposing factor in the causation of nephritis, and further that in the majority of cases of nephritis the attack was due neither to exacerbation of a chronic or latent lesion nor to the previous occurrence of a similar condition.

Conditions in the trenches with the inevitable rat infestation gave rise in 1915 to the prevalence of the sickness to be known later as leptospiral jaundice. Detailed clinical studies were made of the disease in man by collecting cases into a single hospital, and within a year it was shown that *Leptospira icterohæmorrhagiæ* was the cause of the disease and could be found in a considerable proportion of rats in the areas where the cases were being contracted. The observations of the Japanese workers, Inada and Ida, the publication of which preceded that of the work in France by a few months, was thus early and

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amply confirmed. Jaundice is a relatively common disorder in armies in the field, and in France it was shown that the condition might become a presenting feature of enteric group infections. The main problem in connexion with jaundice, however, centred round a very large group of cases encountered mainly in Gallipoli, Egypt and Mesopotamia, the so-called epidemic catarrhal jaundice, now known as infective hepatitis. Twenty-five per cent of certain units of British troops serving in Gallipoli and Alexandria contracted this disease. Valuable epidemiological studies were made and the mode of infection submitted to critical speculation. The investigations designed to show the possible relationship of bacterial infection to the condition were numerous and comprehensive, but negative, an important step in the development of the now widely held conception of its virus origin.

In April 1915 the Army Medical Services in France were confronted with a situation of grave urgency created by the casualties due to the effects of acute lung irritant gases introduced into modern warfare by the enemy. Knowledge of these effects was scanty and such information as there was had been derived from experience of casualties in mines, chemical works and sewers. The clinical and therapeutic aspects of the problem were subjected to close study and principles of treatment were drawn up. It was shown that in nearly every fatal case death occurred within forty-eight hours and often within twenty-four, and that the immediate aim was to tide the patient over this crucial period. Every effort had to be made to get the casualties as quickly as possible to a treatment centre staffed and equipped to deal with them. It was further appreciated that muscular exertion predisposed to the occurrence of pulmonary œdema, the cause of death, and all gas casualties, save the mildest, were treated as lying cases during removal. The technique of oxygen administration was greatly improved as a result of experience gained in their treatment. During the year 1916 the death-rate in lung irritant gas casualties treated was reduced from 24 per cent to 6 per cent. The introduction by the enemy of mustard gas shells in July 1947 was successfully met by the development of a high standard of anti-gas discipline and attention to the requirements of decontamination. In the successful organization of these the Army medical staffs played an active part in the provision of decontamination centres in Field medical units, the organization of the supply of fresh clothing and the provision of suitable preparations for counteracting the effects of mustard gas on the skin.

The segregation of particular groups of cases for special study with a view to achieving a rapid formulation of recommendations for dealing with them was widely used in the first world war, and much information of paramount value to civil medicine accrued thereby. The work of Lewis on Disordered Action of the Heart, submitted in a report to the Medical Research Committee, is a classic of medicine. It discriminates more clearly than had been done before the features and nature of the disease known as "soldier's heart," and shows that this differs in no essential way from disorders seen in civil life, being merely more conspicuous and inconvenient under conditions of military service. The introduction of centres for treatment and study of functional

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neurological disorders produced by the shocks and strains of war yielded somewhat similar results of equal significance and value to medical science. This applied to the majority of these cases in which the causal factors appeared to be emotional. The smaller main group, to which commotion or contusion were ascribed as causal factors, was clearly defined, but the detailed objective assessment of the intellectual impairment arising in such cases awaited the investigations which were organized in the Army during the second world war.

Throughout the theatres of operation in the Middle East in 1915-18 the main medical problems besetting our Armies were those due to malaria and dysentery. With regard to the former it cannot be claimed that much advance was made as a result of our extensive contact with the disease during the war. Much of what we learned was of a negative character. Malaria could not be cured nor could its incidence be adequately controlled in an endemic area by the use of quinine. While no dramatic advance in the treatment of dysentery can be claimed the reverse can be said of its differential diagnosis. In addition to extensive protozoological studies, the diagnosis by cytological methods received more attention than had been given to it previously. This, in combination with cultural methods, enabled the relative proportions of case incidence due to amœbic and bacillary dysentery in theatres of war to be assessed with accuracy. In some areas, as in Gallipoli, prevailing conceptions of the preponderance of amœbic dysentery were shown to be false. A more notable result, however, was the establishment of early diagnosis and consequently the institution of adequate treatment at an early stage of the disease. This applied to both malaria and dysentery. Lines of communication were in many cases very long and were fraught with dangers to the lives of patients suffering from conditions of uncertain nature. Mobile laboratory facilities for diagnosis of malaria were brought into the forward areas and the work done on the differential diagnosis of amœbic and bacillary dysentery by cystological methods enabled larger numbers of cases to be diagnosed and treatment to be instituted in forward medical units prior to their being embarked upon a long journey of evacuation. Much alleviation of suffering and saving of lives were achieved by these means.

A noteworthy advance in medical knowledge during the first world war was the identification of the intermediate hosts of the two species of pathogenic schistosomes in Egypt. The danger of infection by these to large numbers of our Forces in Egypt dictated the necessity of investigation, and the Medical Research Committee in co-operation with the War Office and the London School of Tropical Medicine, sent out a special mission headed by Dr. Leiper. The main problem was successfully solved and fresh-water molluscs were shown to be the immediate hosts. The discovery was followed by the adoption of effective means for rendering the infected water safe for use in our military camps.

The advent of peace found the Medical Services, shrunken in conformity with the size of our small Army, unable to apply within its structure some of the valuable principles evolved in connexion with its organization during war.

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The treatment of neuropsychiatric casualties and much of the emphasis on rehabilitation shown to be necessary during the war, were largely shelved. In the years between the world wars, however, opportunities presenting to Army medical officers for co-ordinated inquiries and the collection of records and data were not neglected. In this connexion the contributions from within the Army to the literature on cysticercosis spring readily to mind. In a brilliant research, now classical, MacArthur showed that somatic infestation of man by *Cysticercus cellulosæ,* the larval stage tapeworm *Tænia solium,* is a common cause of epilepsy developing in British soldiers after a period of service in India, and our knowledge of the pathogenesis of this disease is largely based on his work. Careful and painstaking follow-up studies by Dickson and Hargreaves have brought to light much of the natural history of the disease. In the field of therapeutics the collection of exact data by medical officers in the Army has contributed much to the work which followed the introduction of the synthetic anti-malarial drugs, atebrin and plasmoquine. To this the Fourth General Report of the Malaria Commission of the League of Nation's published in 1937 bears witness. The value of plasmoquine as a drug with a definite effect on the relapse rate of *Plasmodium vivax* infections was amply confirmed by work done by medical officers of the Army in India, and the system they evolved still remains standard treatment for relapsing benign tertian malaria.

The advent of the second world war provided an opportunity for a renewed onslaught against dysentery and malaria. On this occasion, with additional therapeutic resources, measures taken were productive of much new knowledge and greater success. These problems, however, were attacked on fronts other than the therapeutic, and the success achieved by the insecticide dichloro-diphenyl-trichlorethane (DDT) and, in the case of malaria, the repellent di-methyl pthalate in personal protection, which we leave to be told elsewhere, must be ranged alongside the success achieved in the more direct action of drugs brought to bear against the causal infecting agents.

When the struggle to maintain the health of the troops in the Western Desert of Egypt began our resources for treatment of bacillary dysentery had not been rendered more efficient since the preceding world war, nor were we able to combat its prevalence any more successfully. After a period spent in the application of the saline and serum treatments, during which an unconvincing attempt was made to vindicate the use of phage, the appearance of a new sulphonamide, sulphaguanidine, prepared and tested in America by Marshall and his co-workers at the Johns Hopkins University, caused a dramatic change in the situation. The claims made for its efficacy were readily confirmed in our Armies in the Middle East, and so effective did the new preparation prove to be in the very early manifestations and in the established disease that the problem of bacillary dysentery practically ceased to cause further anxiety to the administration.

In the course of the Burma campaign serious difficulties arose in connexion with the treatment of amœbic dysentery. Relying on the efficacy of standard treatment in use before the war—injections of emetine followed by E.B.I. with retention enemata of chiniofon, and later by oral administration of such drugs

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as stovarsol and carborsone—there was a tendency to retain cases in India in the belief that relapses could be adequately controlled by the therapeutic resources available. Unfortunately, shortage of E.B.I. led to many cases being treated in Burma by methods in which specific therapy was represented by emetine injections alone. Many cases showed a tendency to early and repeated relapses, and despite almost continuous efforts to control the condition, they became wasted and bedridden. It was suggested that the infecting parasites were unusually virulent and that repeated courses of emetine injections had produced emetine fastness in them, both views in conflict with the generally accepted opinion based on the work of Walker in 1913 and that of Dale and Dobell during the first world war. Confronted with the problem of treating a cachectic patient with persistent abdominal pain and fever, and passing twenty foul stools containing blood and numerous amœbæ daily, Hargreaves found dramatic improvement followed the intramuscular administration of penicillin, and he laid the foundation for a system of treatment which has turned the scales in favour of satisfactory response in types of amœbic dysentery previously resistant and sometimes fatal. Penicillin has no directly lethal action on the amœbæ but its function in the scheme of treatment elaborated is to eradicate invading organisms and thereby cause the dispersion of the exudate which seems to protect the amœbæ from measures adopted in treatment. Provision for the combating of contingent penicillin-resistant organisms is made by the oral administration of sulphasuxidine. After treatment on these lines it is found that previously refractory cases become amenable to the drugs which have a specific action on *Entamœbæ histolytica.*

The years between the two world wars had seen changes in the fields of malarial therapeutics, and in 1939 we embarked on the war with our therapeutic resources enhanced by the addition of atebrin and plasmoquin, albeit the large-scale manufacturing processes governing their supply were still largely the sole property of the enemy. The anti-relapse value of plasmoquin has been mentioned. Atebrin had been established as an anti-malarial product similar in action to quinine and at least equally efficacious in treatment. In Malaya it had been extensively studied as a suppressive in a dosage of 0·2 gramme twice weekly and reports appeared to show that it was superior to quinine in this respect. In some cases a daily dose of 0·1 gramme had been used. Many of the suppressive trials reported had been in plantation coolie communities, and their acceptance on equal terms for application to European troops was regarded askance. Moreover, animal experiments indicated that liver necrosis might result from large doses of the drug, and among the toxic effects reported in men there were isolated reports of similar lesions, although they were rare and usually occurred in subjects of severe anæmia. The loss of Java to the enemy early in 1942 deprived us of further supplies of quinine, and we had to face the continuing war lacking clear knowledge of how our preparation of atebrin, mepacrine, could best be used as a suppressive drug. To establish the value and safety and the optimum dosage of mepacrine as a drug for the suppression of malaria in European troops and convince responsible authorities that the results warranted its manufacture on a larger scale were

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successful tasks, to some of the credit for which we may rightly lay claim. Results were achieved by the careful surveys of the health of soldiers after continuous administration of mepacrine in daily dosage of 0·1 grm. on six days each week for periods up to eighteen months in West Africa. These included liver puncture biopsies and other liver function tests carried out in cases found with slightly enlarged livers. It was shown that no adverse effects on their health could be demonstrated, and that histologically the liver showed no variation from normal. Although malignant tertian malaria had occurred in the group it was notable that there was no case of cerebral or grave forms of the disease and that neither serious sequelæ nor blackwater fever had occurred. These results are noteworthy and tend to correspond to those obtained in the brilliant research conducted concurrently by Brigadier N. Hamilton Fairley at Cairns in Australia, which led more directly to the control of the clinical manifestations of malaria in troops operating in the jungles of South-East Asia.

During the second world war campaign in the Middle East the man-power of our Armies was again seriously undermined by a heavy incidence of jaundice, the same condition as has been mentioned in connexion with the 1914–1918 war, but with our conception of its pathology having undergone drastic alteration. It had come to be realized that the site of the inflammatory lesion was in the liver involving the parenchymal cells rather than in the bile-duct or its branches. Since 1939 the work aimed at clarifying its ætiology and the method of its spread has been very extensive and much of this has been carried out within the Army. The artificial communicability of the disease by intravenous injection of infected blood and the infectivity of fæces has been demonstrated, but the mode of infection of the disease during the severe epidemics in the Middle East cannot be said to have been solved. Extensive investigations failed to show that the icterogenic agent was spread more readily under conditions of bad hygiene and poor sanitation. The method of infection remains uncertain, and attempts to control the spread of the disease have failed.

More successful results attended investigations into the method of transmission of homologous serum jaundice, a similar disease which was frequently found to complicate the treatment of syphilis with arsenic, and which became a serious problem in clinics where large numbers of patients were having venipuncture and receiving therapeutic substances by subcutaneous, intramuscular or intravenous injection during the years of the second world war. It was shown conclusively in Venereal Disease Treatment Centres that if syringes used were carefully sterilized after each injection this condition did not occur. The incubation period of this jaundice was found to be seventy to one hundred and twenty days, and it was further shown that the blood is highly infectious from very early in the incubation period. Contamination of syringes occurred as a result of their use for venipuncture in groups of patients during this symptomless incubation period under conditions of supply which did not permit of a separate syringe for each patient. It was further shown that the arsenical preparations used did not play any significant part in the production of the hepatitis. The incidence of homologous serum jaundice in patients

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undergoing treatment in Venereal Disease Treatment Centres practically disappeared when the requirements of adequate sterilization were put into practice.

The rehabilitation of the sick and injured with its attendant contribution to the maintenance of morale in the Army and at home has been an achievement worthy of the highest tribute to the military Medical Services during the two world wars. The activation of latent psychoneurotic reacting tendencies by influences incidental to the military system and its function is a constant preoccupation to those responsible for the prevention of unnecessary loss of man-power through sickness and wounds. Much indeterminate disease and low morale was found to centre round the invalidism of gas casualties in the first world war, and a recognition of the part played by environmental factors during treatment contributed much to improvement in results. During rehabilitation it was found that firm control of patients, the avoidance of unnecessary evacuation, and the restriction of periods spent in hospital to a minimum, prevented the patients from falling into a morbid state and developing the functional symptoms which delayed recovery so often. Similar principles applied in cases of so-called "shell shock" resulted in considerable restoration of the impaired morale indicated by the initial heavy casualties from this cause. In the second world war these methods were extended, and convalescence was supervised where necessary in special hospitals and finally in convalescent depots under the supervision of specialists in the science of rehabilitation. In the atmosphere of these latter units with their emphasis on orderly controlled routine of remedial exercises and of military discipline, and with the patient removed from the emotional influences incidental to periods of sick leave spent at home, adverse reacting tendencies were successfully counteracted, and much was contributed to the success of the struggle to maintain man-power. Much valuable experience of rehabilitation was gained during the two world wars and the principles of treatment based on this, which were applied to prevent deterioration of morale in the Army during war, may well have a field of application in industrial and other groups in civil life, and merit wider recognition in the principles and practice of medicine.

In addition to services in connexion with rehabilitation, Army specialists in physical medicine have done other pioneering work which merits recognition as a contribution to the practice of medicine. The problem of the potential recruit who does not conform to the physical standards necessary for enlistment in the Army has seriously engaged their attention. During the second world war, special centres were organized in which systematic physical training, if necessary corrective of specific postural defects, was applied with a view to improvement of stamina and physique. Over 70 per cent of cases sent to these Physical Development Centres attained the standards which enabled them to serve in the Army after a period of graduated training averaging six weeks. The success of their work points to the advantages which might accrue to the nation by its wider application. One such centre is still maintained in the Army.

Skin diseases have always tended to be a serious cause of inefficiency in the Army. In the South African War the average annual incidence of skin disease

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was 23 per 1,000. During the 1914–1918 war skin diseases caused a serious loss of man-power, and in 1915 in the U.K. 40 men in every 1,000 were admitted to hospital for diseases of the skin. In France and Flanders the rate of admission was 126 per 1,000. In the second world war the incidence was relatively high in all theatres, and the importance of skin conditions was reflected in the allocation of 10 per cent of total beds, excluding those required for battle casualties, found necessary for their treatment.

As in the first world war so in the second, scabies was statistically the most important disease. In the Army during the latter the advantages of treatment by benzyl benzoate, which had been used in Denmark by Kissmeyer for some years, were established, and important contributions were made to the researches carried out under the ægis of the Medical Research Council of the Ministry of Health at Sheffield. Following this it was established that a number of persons were silent carriers of the disease and that the incubation period in the average case was six to eight weeks or longer, a much greater period than had previously been considered. Further, great economy of man-power was achieved by the application of the principles established that the Sarcoptes is usually vulnerable, that, unless there is a severe epidemic, the disinfection of bedding and clothing is not necessary and that patients can be cured in their units without having to go off duty. Reference has been made to the control of disease due to verminous infestation during the first world war. The introduction of DDT during the second led up to much greater control of these conditions, and was a milestone in military history in that pediculosis with its subsequent pyogenic infections of the skin was reduced to a factor of little importance. From 1939 onwards impetigo attracted considerable attention and important observations were made on its transmission. Investigation of the desert sores, of which there was a heavy incidence in the Western Desert, pointed to the relationship of this condition to facial impetigo.

With regard to treatment, the dangers inherent in the local application of sulphonamides to the skin became apparent, and we owe to observations by Army medical officers the early appraisal of this two-edged weapon showing the risk of induction of sensitivity and of the light sensitivity which often follows. Much important information accrued from military sources on the subject of cutaneous diphtheria. The adaptation of old large buildings as skin wards was shown to be fraught with the danger of secondary infections of this nature. Virulent diphtheria bacilli were found in roof beams, and important principles were evolved governing the size of wards necessary for the treatment of skin cases. Tropical lichenoid dermatitis was described and its disputed ætiology assessed with particular reference to the part played by mepacrine. Many important observations on contact dermatitis under various conditions incidental to military life were also made in the Army during the second world war, and although the full ætiology of the conditions studied was not solved, these observations will prove to be a firm foundation for a fuller appreciation of the underlying causes. The psychosomatic aspects of a number of skin diseases were also investigated, and results of the work are of considerable importance to dermatological practice. While this should not be ques-

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tioned, it has been stressed in the Army that somatic factors should be thoroughly investigated and the psychological assessment made with considered judgment.

A further contribution to dermatology during the more recent world war, and one of outstanding merit, was made in the important and wider field of rehabilitation. The work was carried out in an auxiliary hospital at Ragley Hall, Warwickshire, where patients who had spent on an average two-thirds of their Army service passing from hospital to hospital, were taught satisfactory personal adaptation to their disease compatible with the performance of useful work and the culture of physical fitness. This work was a valuable contribution to individual and national morale during a period of stress incidental to a serious man-power situation.

The foregoing cannot claim to give more than brief mention of the problems to which physicians in the Army have applied their genius and industry. The structure of the principles and practice of medicine to-day bears witness to the fruits of their work. Few communities lend themselves so well to the cultivation of team work in the field of the investigation, prevention and treatment of disease as the Medical Services of the fighting forces. The resulting integration of thought and action is apparent in the emphasis laid by Army physicians on preventive medicine in addition to their contributions to the study of established disease. Their breadth of vision is revealed in many impassioned and eloquent appeals they have made for more adequate representation of our best professional resources in the forward area of the battle zones. They have stressed the principle often repeated during the past fifty years that the Medical Services of the Army can only function efficiently on a foundation of regimental medical officers with energy and initiative, a sound knowledge of preventive medicine in all its aspects and of the men under their medical charge as well as of the diseases liable to beset them. Despite the distractions incidental to a post-war era of more elaborate and increasing specialization, the future of our Corps is bound up inextricably with this ideal.

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ADVANCES IN MILITARY PATHOLOGY DURING THE PAST FIFTY YEARS

BY

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THE fifty years which have elapsed since the formation of the R.A.M.C. in 1898 to the present day is a long time in the measurement of scientific achievement so that any survey of the advance in Military Pathology during that period must, of necessity, be in the nature of a series of rather incomplete sketches, if such an account is to be of reasonable length. Two world wars have profoundly influenced this advance in a way no other circumstance possibly could. New problems demand new techniques in pathology as in any other science, new diseases demand new methods of diagnosis and attack, and new methods of waging war require most careful study and preparation, if we are to guard against them as we ought to do. In considering these advances, too, and the manner in which they were made, we must recollect that, in the early days of the Corps, research in pathology (as in other branches of medicine) was organized somewhat differently from to-day; neither the Medical Research Council nor its forerunner the Medical Research Committee was in being, so that effort in research tended to be somewhat more individual than it is to-day, though urgent problems such as that presented by the ravages of Malta fever and sleeping sickness called for a combined effort resulting in the formation of Commissions of the Royal Society to attack the problem and solve it. Finally, in a review over such a period of time it is only too easy to give undue prominence to one part of it at the expense of another, or to one aspect of pathology to the detriment of others equally or even more important; for example, from the very nature of the duties of the Corps, much of our survey must lie in the realms of tropical medicine and pathology which may, therefore, seem to receive undue attention.

EARLY DAYS

Military pathology was, of course, built on firm foundations many years before the formation of the Royal Army Medical Corps and many famous members of the Medical Staff Corps and Indian Medical Service were trained at the Army Medical School at Netley prior to 1898. At the beginning of our era, Dr. (later Sir) Almroth Wright was Professor of Pathology at the Army Medical School — an appointment which he had held since his return from Australia in 1892. It was during this period at Netley, while giving instruction to one-time surgeons-on-probation—now for the first time officers of the R.A.M.C.—that he pursued his epoch-making work on anti-typhoid vaccination. In 1898, a trial of the vaccine was first instituted on a fairly large scale in volunteers in the British Army in India, and in the following year no less than 30,000 men were inoculated against typhoid fever on board ship, the majority being *en route* for South Africa. Wright's assistant and able collaborator at this time was Major A. D. Semple, R.A.M.C., shortly to become the

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first Director of the Pasteur Institute of India, Kasauli, which had the distinction of being the first of its kind in the British Empire. Another member of this pathology team at Netley, because it was a team in the real sense, was Captain W. B. Leishman, R.A.M.C., who, on his return from India in 1897, was posted to the Victoria Hospital and soon entered enthusiastically into all the work going on in Wright's laboratory, including that pertaining to anti-typhoid inoculation and investigations into Brucella infections. In 1900, Leishman succeeded Semple as Assistant Professor of Pathology and it was very soon after this that he made his first original contribution to medical literature in his article on "A method of obtaining rapid Romanowsky staining by a single solution" published in the *British Medical Journal* (1901). The stain is known as Leishman's stain the world over, and has been used successfully by thousands of clinicians and pathologists ever since. The method surpassed those previously employed, in not requiring preliminary fixation of the blood-film, in being very much more rapid—five to ten minutes instead of two hours or more, and in not giving a deposit on the film. It would indeed be difficult to overestimate the influence of the Army Medical School on the course of tropical pathology and medicine in the world at large through the work of men like Bruce, Ross, Leishman, Cummins, Horrocks, Lewis and very many others.

South African War to First World War

Enteric Group Fevers.—Recollection of the South African War by the epidemiologist at once evokes thoughts on typhoid fever, as this disease occasioned no less than 57,684 admissions to hospital and 8,020 deaths in a force of 208,000 men. There were, in fact, many more admissions than this, because at that time a number of the milder cases of enteric fever were listed under the term "Simple Continued Fever" and were recorded as such. The diagnosis of "Continued Fever" included enteric fever and simple continued fever and the differentiation between these two conditions is difficult. It is essentially a matter for laboratory diagnosis. At the time of the South African War (and in fact for too many years afterwards) the importance to the Army of a properly organized Pathological Service with central direction was not recognized, so that a fully functioning laboratory service was not generally available. It is true that a General Hospital had a laboratory but its scope can be gauged from its equipment table, which stated "Instruments, appliances, drugs, etc., necessary for Pathological and Bacteriological Laboratory—Regulation Allowance NIL—Required 1—all to be packed in one case complete." When bacteriological investigation was made into cases of so-called "simple continued fever" many proved in reality to be cases of "larval, abortive and extremely irregular enteric fever," as we would expect. Blood culture was not then the *routine* diagnostic laboratory procedure of choice it has since become in the Army of to-day. Nor, was the real danger of the "healthy carrier" in the spread of enteric fevers and other infections fully appreciated at the time. More attention was given to "soil and water" and even to aerial contamination, as possible sources of infection; for example, in the Report of the Health of the Army for 1900, "emanations" arising from a neighbouring prisoner-of-war camp

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occupied by Boers was suggested as the cause of an outbreak of typhoid fever in the 2nd Kings Royal Rifles, who were doing guard duties. The continuous and original research of many officers of the R.A.M.C. in India and elsewhere at this time contributed greatly to the advance in laboratory methods of diagnosis of enteric group infections. Mention has already been made of the introduction of Wright's inoculation against typhoid fever, but the numbers inoculated in South Africa were relatively too few for a correct assessment of the value of this procedure. That advance had to wait for some years.

Dysentery was responsible for 38,000 admissions and 1,342 deaths in the South African War and was secondary only to enteric fever as a loss of man-power. At this time, the dysenteries were classified as endemic, epidemic and sporadic, and it was recognized that epidemics were normally bacillary in origin. None the less, bacteriological investigation of bacillary dysentery was very much in its infancy as Shiga first described his bacillus in 1898 and Flexner described his strains only in 1901. It is difficult to appreciate now, that fifty years ago the causation of tropical abscess of the liver had not, in fact, been traced to *Entamœba histolytica* and that medical treatment of the condition was non-specific. Case-records of tropical abscess of the period with their accounts of repeated attacks of dysentery impel regret that the ætiology of the condition had not then been discovered.

Leishmaniasis.—The finding of a new protozoon in the spleen of a soldier suffering from " Dum-dum fever " by Major W. B. Leishman, R.A.M.C., was one of the most interesting and important discoveries of the early twentieth century. One must pay tribute to the keen observation which enabled Leishman to detect these minute bodies in the splenic pulp. There can be little doubt too, that an excellent staining technique contributed to his success because at this time he was working on the Romanowsky stains, and was to publish his note on his method of staining in the following year (1901). Leishman thought at first that these bodies might be fragmented nuclei of trypanosomes and did not place his observations on record till some three years later. Some time after, in the Army Medical School, Wright found Leishman-Donovan bodies in the lesions of "tropical ulcer" establishing the ætiology of this condition. It was not, however, until some time later that successful transmission of kala-azar by the bite of the sandfly was effected by the notable work of members of the Indian Medical Service. The sandfly had been incriminated on epidemiological grounds for many years, as the transmitter of Leishmania infections but it was only during the recent war that this was proved by workers in India who successfully infected volunteers by sandflies which had been kept alive by a newly discovered method of feeding.

Sleeping Sickness.—The following announcement appeared in the *London Gazette* of December 18, 1903: " The undermentioned Lieut.-Colonel to be Colonel—David Bruce, F.R.S., M.B., R.A.M.C., in recognition of his services in investigating the cause of ' Sleeping Sickness ' in Uganda, as well as in consideration of the distinction already attained by him in researches connected with Malta fever and tsetse-fly disease." This was the first brevet promotion to be awarded for distinction in original research. Our knowledge of medical

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trypanosomiasis dates back to the days before the formation of the R.A.M.C. in the discovery of a trypanosome in the blood of rats by Surgeon Major T. Lewis, F.R.S. In 1903 Bruce joined the Commission on Sleeping Sickness already established in Entebbe, Uganda and, with his work on tsetse-fly disease in cattle fresh in his mind, was quick to appreciate the great significance of Castellani's discovery of a trypanosome in the cerebrospinal fluid of cases of sleeping sickness, seized upon it and pursued it in collaboration with Castellani to whom Bruce was the first to give credit for the discovery of the parasite.

Other members of the Corps working under Bruce at this time in the Sleeping Sickness Commission were Captains Hamerton and Bateman. Finally, we must pay tribute to the memory of Lieutenant Forbes Tulloch, R.A.M.C., another member of the Commission, who was infected with trypanosomiasis in Uganda and died of a virulent form of sleeping sickness in London in June 1906. Published works of the Commission included studies on the development of *T. gambiense in Glossina palpalis*, on trypanosomes found in the blood of wild animals, and on trypanosomes as a cause of disease in domestic animals. They found time, moreover, to study a disease of the native known as "Mukinyo" which proved to be undulant fever, and a disease of cattle known as "Amakele," which was, in fact, the same as East Coast fever and was due to the presence of a piroplasma in the blood.

Brucellosis.—Undulant or Malta fever (now included with contagious abortion in the much more comprehensive term of brucellosis) was a serious drain on the man-power of Army and Navy in Malta over a period of years. This is not to be wondered at when it is realized that the average duration of an attack is four months. Little advance had been made in the control of the disease since the discovery of the organism by Bruce in 1887, its method of entry into the body having defeated all attempts at solution. Wright and Semple of the Army Medical School by means of the agglutination test did much to demonstrate that the distribution of the disease extended widely beyond the confines of Malta and Mediterranean, and to differentiate this infection from enteric, malaria, and other specific fevers. But as late as 1904 no one had found the parasite in "external nature."

There were various theories on the mode of entry of the organism into the human body; at one time drinking water was blamed, and at another time a biting fly was thought to be responsible, but neither theory fitted in correctly with the epidemiology of the disease in Valetta. In the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS of May, 1904, a plea was made for the appointment of a Commission of whole-time officers to attempt to elucidate the method of infection of this disease which was responsible for so much sickness and invaliding in both the Navy and Army. Whether as a result of this or not, a Commission was appointed in the same year with Bruce as President and, in the following year, the problem was solved by the discovery that the goat was a highly susceptible animal. Prior to this, the goat had been presumed immune and in no way involved in the spread of the disease, because it had not been found possible to infect it with artificial cultures. Agglutination tests proved that *Brucella melitensis* flourished in the goat without producing obvious

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symptoms and investigations soon showed that half of the goats in Malta were infected, and that 10 per cent. of them had infected milk. Preventive measures based on these discoveries were impressive in prevention of the disease, and laboratory investigations on similar lines in other parts of the world, elucidated the wide geographical distribution of this infection.

The First World War

In the years preceding the 1914–18 war, the importance to the Army of a well-organized Pathology Service in the diagnosis, prevention and treatment of disease was gradually becoming recognized and the training of regular pathologists had been proceeding steadily, so that the number available at the outbreak of war was more than enough to fill the few pathological posts authorized. But, the need for regular officers to fill field appointments was so great that after six months of war, only four of the regular qualified pathologists remained in the practice of their speciality. The support of civil pathologists and bacteriologists was fortunately forthcoming to fill the ranks of the Pathology Service.

The first anxiety in this war was the unexpected prevalence of tetanus and gas gangrene, and this was one of the early problems faced by Colonel Sir William Leishman on his appointment to the expeditionary force in October 1914, in an advisory capacity.

There were three types of laboratories in the field: (1) Mobile bacteriological laboratories; (2) hospital laboratories; and (3) research laboratories. The mobile laboratory was something entirely new, as bacteriological investigations had never before been carried out so near the front line in any previous war. The first mobile laboratory to go to France in October 1914 was a converted pleasure caravan stripped of all non-essential fittings and fitted with incubators and other apparatus. These laboratories performed a most useful function in the carrying out of routine clinical pathology, carrier tests, and investigations into new and little-known forms of disease such as trench fever, spirochætal fever, gas gangrene and trench nephritis.

Tetanus.—The incidence of tetanus had been negligible in the South African War, but in this war there were approximately 2,529 cases as a result of the fighting in France and Belgium and the incidence was greatest in the early days. Many of us remember seeing these cases of tetanus in the base hospitals of the United Kingdom after the retreat from Mons. Anxiety was great, and the War Office appointed a committee under the chairmanship of Sir David Bruce to investigate the problem. The prompt administration of a prophylactic dose of antitoxic serum to all wounded men will rank as one of the triumphs of the war, not only in reducing incidence but in many cases modifying the course of the disease, when it did occur. It was clearly shown that serum prophylaxis prevented the onset of tetanus completely, in at least five out of six men. Bruce calculated that some two million doses of serum were administered in England alone, and it is worth recording that there were only eleven cases of anaphylactic shock, and not one was fatal.

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Gas Gangrene.—The second early cause of anxiety was gas gangrene, which also had been negligible in South Africa. It soon obtruded itself in unpleasant fashion at the battles of the Marne and the Aisne, occurring in 10 to 12 per cent of the wounded. Its ætiology was then unknown, and it rather tended to be looked on as a "hospital infection" until the investigation of Sir Anthony Bowlby and Sydney Rowland in one of the new mobile bacteriological laboratories proved that the gangrene occurring among the wounded was a "traumatic infection" originating at the time of wounding, and was due to the entry of an organism from the soil, and that it was in no way related to sloughing phagedæna or so-called "hospital gangrene." It was not, however, until 1918 that antitoxic sera were available for use in the British Army, and then they were limited in scope and not very potent in effect. An efficient method of manufacturing the highly potent polyvalent serum available to us in such generous amount during the recent war, had not then been discovered. But, as a result of the work done at this time it was established that most promise lay in the use of serum in prophylaxis, that the serum should be active against several organisms of the gas-gangrene group, that it should be given as a routine, and that in treatment, serum must be regarded as an adjuvant and not a substitute for efficient surgery.

Wound Sepsis.—The war of 1914–18 provided the first opportunity since the introduction of aseptic surgery, of studying grossly contaminated wounds on a large scale. Suffice it to say that there were two distinct schools of thought and much laboratory and clinical work was expended by both of them. One school placed its faith in "physiological" methods and rejected the use of antiseptics. Sir Almroth Wright was the protagonist of this school. Lorrain Smith and Dakin upheld the second school which trusted more in germicides of one kind or another.

Enteric Group Infections.—The greatly reduced incidence of enteric group infections as compared with the South African War, is one of the outstanding features of the medical history of the war. After making due allowance for the part played by military hygiene and also for the more correct appreciation by the combatant officer and soldier of his share in the practice of hygiene in producing this result, there were two other factors of great importance. One was, of course, the general immunization against enteric group infection, and the other was a more correct appreciation of the danger of the "healthy carrier" in the spread of infection. Antityphoid inoculation had been tried out very tentatively in South Africa, and subsequent work in India under Leishman's direction had demonstrated the value of this procedure. Methods planned in advance were put into practice, and the whole Army was inoculated in a couple of months. In August 1914, only 25 per cent of troops were inoculated before embarking for France but by the end of 1915, due to Leishman's efforts, 98 per cent of troops were protected, and enteric fever which had broken out and spread, started to decline. If the rate had been similar to that in South Africa, there would have been half a million cases and more than 77,000 deaths. Actually, there were 20,000 cases of enteric fever in all theatres of war and 1,191 deaths. Early in 1916, triple T.A.B. vaccine was introduced

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to provide protection against the paratyphoid fevers in addition to typhoid fever, with beneficial effect.

It had been known for many years that "carriers" existed, but this knowledge had not been utilized to the full. Pathologists in India and other foreign stations contributed largely in the inter-war period, to a true appreciation of the carrier danger. Methods of detection have greatly improved since then, by the introduction of highly selective culture media, rendering the detection and isolation of typhoid carriers a much more practicable proposition. In the 1914–18 war, the macroscopic agglutination test of Dreyer and the method of serial agglutination tests were widely practised in an attempt to overcome the diagnostic complication of universal T.A.B. inoculation; for many years after, in India and elsewhere, military pathologists strove to evaluate the agglutination test in an inoculated community at its true worth. And, as a result, our knowledge is now on a factual basis and the limitations of the tests correctly understood and applied in medical practice.

Dysentery—bacillary.—Initially, on the Western Front, bacillary dysentery was not a problem but, later, Mesopotamia and the Eastern Mediterranean contributed more than their share of this disease. Cases arriving in England were concentrated in special areas, and subjected to careful study, but the knowledge gained was not commensurate with the labour expended. It was not at first appreciated that the case must be studied in the laboratory in the acute stage. But by the summer of 1916, dysentery diagnosis had come to form a considerable part of the work of all laboratories on the Western Front. New techniques in diagnosis were evolved and one of them, the direct microscopic examination of material from the bowel, was an advance of tremendous practical value because in this way the rapid diagnosis of large numbers of cases became a practical proposition. By 1917, there were well-equipped laboratories in all the main theatres of war, and a careful study of the strains of organisms isolated as a result of their work was carried out at the Royal Army Medical College.

Dysentery—Amœbic.—Progress in our knowledge was slow at first owing to a scarcity of trained protozoologists, as few pathologists had had any experience of the microscopical examination of stools. But intensive training in the study of protozoology was begun and continued to the end of the war with excellent results. Rapid microscopic diagnosis of the type of exudate was as important as in the case of bacillary dysentery.

Typhus Fever and Trench Fever.—The ætiological significance of ***Rickettsia prowazeki*** had been firmly established just before the outbreak of war, but British medical officers had little opportunity of advancing knowledge because they encountered typhus under conditions unsuitable for pathological research. Active immunization was in its early stages and the results of vaccination were inconclusive. Trench fever was not definitely accepted as a rickettsial infection at the end of the war, though it was established that it was transmitted by the body louse and that the blood of trench fever patients might contain the virus for many months. McKee, who had charge of a mobile laboratory took a large share in the experimental pathology of this disease, and it was through

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his efforts that the infectivity of a patient's blood for man was proved. It was also demonstrated that the virus was contained in the corpuscles, and that clear serum was non-infective. Certain British medical officers carried out some very suggestive experiments on themselves in demonstrating the infectivity of lice. Although the exact nature of the virus had not been established by the end of the war, it was thought to be rickettsial and sufficient knowledge had been acquired for prophylactic measures to be adopted on a rational basis.

Weil's Disease.—Localized outbreaks of Weil's disease, particularly in the Ypres Salient in the summer of 1916, provided opportunity for study. It was demonstrated that 30 per cent of the rats in the area were excreting *L. icterohæmorrhagiæ* in their urine and that live spirochætes were present in the urine of convalescent patients for several months after clinical recovery.

Cerebrospinal Fever.—The spread of meningococcal infection amongst the troops training in England during the early months of 1915 occasioned serious concern and, naturally, stimulated intensive study. Any suspected case was visited at once by a trained bacteriologist. A central cerebrospinal fever laboratory was established at the R.A.M.College and laboratories in all commands were equipped as special centres for study.

Our knowledge of the manufacture of suitable culture media for growing this delicate organism and of its antigenic structure were advanced. The "striking distance" of droplet infection, and the co-relation between the anti-endotoxic value of a serum and its therapeutic efficiency were demonstrated. The new information acquired was of value in the prophylaxis of this disease and was of the greatest value in establishing a specific method of treatment in the days before the sulphonamides and penicillin came to our aid. In 1914, it was calculated "that a man attacked by the disease had on the average only one chance in three of escaping death, whether he was a civilian or a soldier... The progressive improvement shown by the military results was due no doubt to early diagnosis and treatment, the proper use of lumbar puncture, and especially in the last year, to the use of an effective serum. In 1918–19 an attacked soldier, if his disease was of Type I and serum was available, was given close to nine chances out of ten of escaping death." These words are quoted from the Introduction to the Medical Research Council Report on Cerebrospinal Fever 1915–19, and for much of this work we are indebted to Dr. Mervyn Gordon.

Schistosomiasis.—A notable advance in the solution of the Bilharzia problem in Egypt was achieved by Leiper when he demonstrated that the life-cycle of the Egyptian schistosomes followed, in practically all details, that of *S. japonicum* previously elucidated by the Japanese.

The Inter-War Years

The Pathology Directorate was created in 1919, and Sir William Leishman, who had been Adviser in Pathology first in France and later at the War Office, was appointed first Director of Pathology. The Advisory Committee came into being in the same year and, at its first meeting, the Director intimated that, in his view, it should concern itself rather with fundamental inquiries

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into the origin and prevention of disease than into work of a routine nature in connexion with any one special condition. Antityphoid inoculation was a frequent subject of discussion at the early meetings. In 1926, Manifold reported from India that practically all the dysentery in Poona was bacillary in origin due to the Flexner group of organisms, and that amœbic dysentery was much less common than had formerly been supposed. During this period, a great deal was done in the reconstruction and building of laboratories at home and abroad—particularly in India where new laboratories of excellent construction and good design were built in Commands and Districts, i.e. Meerut, Quetta, Lahore, Secunderabad, etc. Two advances in the field of tropical medicine and pathology during this inter-war period, which were of the greatest importance to the Army, were the discovery of immunization against yellow fever by the Americans and the introduction of atebrin by the Germans.

J. S. K. Boyd's classical work in India on the dysentery bacilli placed our knowledge of the antigenic structure of this group of organisms on a firm basis. He demonstrated the inadequacy of the previous system of classification of the large and important mannitol-fermenting group of organisms based, as it had been, on an unavoidably incomplete collection of dysentery strains, many of which had undergone variation, an unrecognized phenomenon at the time of the original classification. Due to his investigations a scientific classification was made possible. A voluminous amount of work was carried out in this field by pathologists in India and elsewhere.

The Salmonella group of organisms were attaining a new significance as a result of methods of antigenic analysis, and several new strains were added to the growing collection by Major R. F. Bridges, R.A.M.C. The efficacy as a vaccine of the Rawlings strain of *Bact. typhosum*, which had been employed since the time of its first isolation in 1900, as the typhoid component of the antityphoid vaccine of our own and many foreign countries came under suspicion a few years prior to 1934. As a result of a series of investigations at the Royal Army Medical College these suspicions were confirmed and the value of selected virulent typhoid strains in vaccine production was demonstrated. The discovery of the Vi antigen of *Bact. typhosum* by Felix and Pitt, followed in its turn by the discovery of a highly specific Vi bacteriophage by Craigie were incidents of great epidemiological and immunological significance and interest to the military bacteriologist.

1939–1946.—In the recent war, the scope of the pathology service became wider than ever before, due to the rapid advance in subjects within its purview. The service was responsible not only for the supervision of hospital and mobile bacteriological laboratories and for the organization of research in laboratories, but also, in co-operation with Consultants and Advisers in all branches of medicine and surgery, for the scientific control of chemotherapeutic agents, penicillin therapy, immunization procedures, vaccines and sera. In the Blood Transfusion Service alone, the development of which was one continual advance in method and organization, there was scope for almost unlimited work. Research was organized and directed with the help of the Medical Research

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Council by the formation of teams designed to work on urgent problems as they arose. Teams to study shock, typhus, anaerobic infection and penicillin control were examples of such research, apart from the continual investigations in many other fields too numerous to mention—common cold, influenza, infective hepatitis, therapeutic trials, effects of immunization, etc., etc. Many of these teams functioned in the field in specially equipped mobile bacteriological laboratories. Central laboratories were established in the Middle East and India and an Emergency Vaccine Laboratory was formed in England. Apart from performing routine work these laboratories constituted highly specialized reference laboratories and centres of instruction, in which research of one kind or another was constantly in progress. It is obvious, therefore, that in this enormous panorama only the barest outlines can be given.

Tetanus.—The incidence of tetanus in the wounded, fighting over the same terrain was less than in the previous war. A ratio of 1·47 per thousand in 1914–18 on the Western Front fell to a ratio of 0·43 per thousand in troops in France in 1939–40, and to a ratio of 0·06 per thousand in 1945 in over much the same ground. The main reason for this comparative immunity is believed to lie in the general active immunization against tetanus which was instituted in 1939. Between the two wars, active immunization against both diphtheria and tetanus was developed. The Army took a very active part in the development of tetanus prophylaxis, and tests on dosage and the optimum interval which should elapse between doses were carried out by Boyd at the R.A.M. College. Immunization prior to proceeding on active service was adopted, and there can be little doubt that it greatly reduced the incidence of tetanus in World War II.

Gas Gangrene (*Clostridial Myositis*).—The knowledge of the pathology, bacteriology and treatment of gas gangrene gained in 1914–18 was advanced considerably during the recent war. The War Wounds Committee of the Medical Research Council set up in 1942 an anaerobes Sub-Committee of which the Director of Pathology was Chairman, to inquire into the prevention and treatment of anaerobic wound infection, particularly gas gangrene. In addition to directing research, the anaerobes sub-committee was concerned very largely with the rapid propagation of knowledge. Special courses were arranged for Army pathologists in the bacteriology of anaerobes. Information on gas gangrene treated in the United Kingdom was mainly derived from analysis of case reports but very valuable information on anaerobic infections of war wounds was obtained as a result of an investigation by Major J. D. Maclennan, R.A.M.C., originating in the Middle-East Force and continuing in Italy and France. Apart from the excellence of the bacteriology, the centralization of the work in one laboratory was clearly of the greatest value in obtaining the maximum information from a comparatively small number of cases. The results of these investigations have, of course, been published and we can only deal with them here very briefly and incompletely. Points of particular interest in this report were the descriptions of infections with *Cl. œdematiens* and the description of streptococcal myositis; also the relative importance of the soil and the clothes as sources of infection, the association of proteolytic

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organisms, particularly *Cl. histolyticum* with a high mortality rate, and the beneficial effect of antitoxin in treatment. The relationship of the nature of the infecting organisms both to time of onset of the disease and to its mortality was traced by Maclennan. When only one of the pathogenic Clostridia was present the average time of onset was twenty-three hours. The mortality rate tended to rise if more than one of the pathogenic Clostridia or a proteolytic Clostridium, was present, and reached 100 per cent in the presence of *Cl. histolyticum*. Our knowledge and understanding of this grave infection increased substantially during the war so that better methods of prophylaxis and treatment were introduced with improved antitoxins and new drugs to supplement treatment with surgical measures which remains the most important prophylactic measure.

Penicillin Research.—The Army penicillin research organization consisted at first of surgeon, bacteriologist and technicians working in the different theatres of war with the limited supplies then available. Reports of both early and late treatment of infected wounds had confirmed the early promise of the value of penicillin. As supplies became more readily available, the laboratory aspects of penicillin investigations in hospitals on active service received widespread attention in hospital laboratories and specialized units. Detailed attention was given to its stability, dispensing, sensitivity, activity alone and in combination with various sulphonamides. Its value in wounds in general, and in head wounds, chest wounds, joint injuries, in particular was a subject of continued study in collaboration with the clinician. Its value in medical treatment was controlled, and different techniques for its estimation in body fluids examined in the laboratory. Penicillin was the object of tremendous attention resulting in great advances which have only been briefly hinted at. Apart from well-organized co-ordinated research for which the war provided a unique opportunity, it is little exaggeration to say that there was scarcely any laboratory at home or abroad in which the pathologist did not devote such time as he could spare at the bench, to the practical study of penicillin in its various aspects.

Blood Transfusion.—It would be difficult to imagine any subject in which the advance in knowledge and in practice was so great as in that of blood transfusion. It can only be described as revolutionary. Blood transfusion from being a procedure of frequency only in hospital practice was introduced to front-line units and was given anywhere. Boxes containing dried serum, and crystalloids together with powdered blood-grouping sera, with the apparatus, for the taking and giving of whole blood from local donors, were carried, by all forward medical units, hospital ships, troopships, ambulance trains, etc. These boxes enabled small numbers of transfusions to be undertaken in emergencies when continuous contact with either the Army Blood Supply Depot or a Transfusion Unit was not possible. New products were made, new methods introduced and new units formed to function in their great expansion. The work of the Army Blood Transfusion Service under the direction of Sir Lionel Whitby will live for many years as an example of outstanding achievement in the second world war. Some idea of the volume of work may be

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obtained from the fact that between September 1939 and May 1945 120,817 pints of blood, 342,103 bottles of dried plasma and 345,442 pints of crystalloid solutions were sent out from the Depot and that there were 559,529 individuals on the donor panel for giving blood. It is impossible to detail all the special investigations of the pathology service into transfusion technique, the drying of plasma, manufacture of grouping serum, prevention of shock, etc., etc., which were carried out.

Typhus.—Knowledge of typhus control differed little in 1939 from what it had been at the end of the 1914–18 war, during which millions had died of the disease in central and eastern Europe. And yet the expected holocaust did not occur, though typhus was rife in many battle areas. Africa, Burma, Irak, Persia, Italy were all centres of infection and the menace in Europe was, if anything, intensfied on the cessation of hostilities with a devitalized and undernourished people open to attack. What prevented the spread? Undoubtedly DDT and active immunization played the major part. Before and during the war much time was devoted to antigenic analysis of the various typhus Rickettsiæ, upon which the principles of immunization and diagnosis both depend. Intensive work was done in the United States and in this country, and not least in the military laboratories at home, in India, Burma, Persia, Irak and Egypt during the war. Strains of Rickettsiæ were flown home from the different theatres for study, and antigenic analysis necessary for the preparation of diagnostic material and vaccines. The larva of the mite *Trombiculu deliensis* the vector of scrub typhus, which infests localities in South East Asia can be avoided only with difficulty. A special vaccine was prepared against it from the lungs of infected cotton rats. This vaccine had been shown to confer protection on laboratory animals, but the sudden end of hostilities prevented completion of the trial and results were inconclusive: now a new antibiotic—chloromycetin—seems to promise assistance in this field.

Influenza.—Advance in the study of influenza provides a further good example of the beneficial result of co-operation between pathologist and clinician. Cultivation of the virus on the developing chick embryo, the isolation of influenza-B virus and the discovery that influenza virus agglutinated fowl red cells and the fact that this agglutination was specifically inhibited by appropriate immune sera were discoveries of the greatest practical importance in the study of this infection, and in specially equipped laboratories much investigational work was done. Bodies of troops were immunized to study the immunogenic value of influenza vaccine containing viruses A and B, but for lack of adequate opportunity a convincing trial in this country was not forthcoming, and the value of the vaccine remains undetermined.

Infective Hepatitis.—As in the 1914–18 war, so in the recent war, infective hepatitis attacked the armies in the Field, to a degree that is not generally realized—and the Army at home did not entirely escape. The impact of attack was felt very severely in the Middle-East Force and Italy. Although many gaps in our knowledge remain, considerable advance was made. So much of this advance was due to combined action that it is invidious to attempt to differentiate the laboratory worker from the clinician. Infective hepatitis

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reached epidemic proportions in the Middle-East Force and intensive investigations were made by Cameron and others with the mode of transmission and the discovery of the responsible agent. He demonstrated the artificial communicability of the disease by injecting six human volunteers intravenously with infected blood—all attempts at animal inoculation having proved fruitless. Van Rooyen and Gordon continued investigations into the isolation of a possible virus agent employing in their work a wide range of animals. These tests were also unsuccessful, but various facts emerged such as the immunity of local inhabitants, the significance epidemiologically of subclinical attacks and the liability of officers in the Army (as distinct from the Navy) to contract infection. Following on the discovery of the infective agent in fæces, van Rooyen postulated some lack of acquired herd immunity on the part of officers through less exposure to casual excremental infection an explanation of their increased incidence. This is not generally accepted.

Homologous serum jaundice and the possibility of syringe-transmitted infection became a serious problem in connexion with transfusion of plasma and in arsenotherapy. It was suggested by Biggar and also by MacCallum that hepatitis was being conveyed through venepuncture and intravenous injections. It soon became evident through the work of Sheehan, Salaman and others that this hypothesis was correct.

Diphtheria.—Although diphtheria never reached serious epidemic proportions it naturally received much study and special interest, because it was always present in the forces. Following on a really intensive immunization of children in 1940, the subject of mass immunization of the troops against diphtheria was continually under review, particularly in the Middle-East Force, where the incidence had been high in certain units. But the work of Boyd on the reaction in the adult resulting from the injection of A.P.T. clearly showed that position of young children and soldiers in a force, was not at all comparable and that more harm than benefit would accrue from blind mass immunization of an adult Army in the Field and that, in any case, it was unnecessary in view of a process of natural immunization during the preliminary years of army communal life. On the other hand, immunization of the recruit as now practised is a well worth-while procedure as a long-term policy.

New bacteriological methods of supplementing cultures on Loeffler slopes by culture on blood-agar media containing potassium tellurite was widely practised in all laboratories and resulted in a much higher degree of accuracy. The role of *C. diphtheria* in wounds received much study and led to the conclusion that it was a secondary invader only, and not a primary agent and that it was present mainly when infection elsewhere was also present.

Bacillary Dysentery.—Shiga infections were not uncommon and it was noted in the Middle East that the ordinary concentrated antitoxin did not have any marked therapeutic effect. Trials of a new specially refined antitoxin were initiated but the introduction of the treatment of bacillary dysentery by the sulphonamide preparations in adequate dosage, were little less than dramatic and in a short time outmoded any other form of treatment.

India.—A word or two more must be said about work in India where, for

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example, the service expanded from a total of 27 laboratories in 1938 to a total during the war of over 120 laboratories spread all over India and the Burma theatre of operations. In addition, laboratories which had been raised in India served in the Middle East, Italy, Irak and Persia. The Central Military Pathology Laboratory was constantly engaged in training pathologists to fill places created by the expanding service, and by its Departments of Histopathology, Bacteriology and Serology and Biochemistry was able to give a full consultative service when required. The pool of research workers investigated many urgent problems and valuable work was carried out by these teams with problems connected with scrub typhus, tropical anæmias, amœbic dysentery, sprue and schistosomiasis.

The work of the blood transfusion section of the pathology service in India deserves some special mention. It is hard to appreciate the energy and organization which made it possible for blood drawn in Dehra Dun or Poona to be dropped in Burma seventy-two hours later, yet such was a usual occurrence. It was the proud boast of the blood transfusion officers in India that no wounded man in Burma was ever denied a transfusion on account of lack of blood.

At the end of 1947, the service, so far as the officers of the R.A.M.C. were concerned, came to an end. The plans made during the war years had come to fruition and other schemes for the betterment of the service had been approved and handed over to our successors in Pakistan and India.

As was stated in the introductory paragraph, the fifty years which have just passed, is a long period of time to cover in a survey of progress in military pathology. It has, therefore, only been possible to sketch in the more notable progress, even then with many omissions, without reference to the hundred and one advances in method and technique which have been developed in all branches of the subject during that long period of time. Many new problems confront the service but there is little reason to fear that they will be tackled and overcome as they were in the past.

Acknowledgment is due to many official reports and memoranda, to Reports on the Health of the Army and not least to many past numbers of this Journal in the completion of this account.

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FIFTY YEARS OF SURGERY IN THE ROYAL ARMY MEDICAL CORPS

BY

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A HALF-CENTURY ominously ushered in by a war, albeit one run on sporting lines, the last of the humane wars; then a short decade, free only in its early years from the gathering war clouds, only remembered as their training years by the oldest now serving; and all the rest a crescendo of wars; no wonder that it is the record of half a century of progress in war surgery. For the regular Army surgeon it has been a career devoted to war, with lesser wars between greater wars, against Mahsuds, Moplahs and Marris, Afghans and Afridis; little else than wars and preparations for war; and for the civilian surgeons, years in uniform, for many a one, a third of his professional life.

It has been a half-century of surgical striving, step by step in every climate, in the cold wet infected mud of Europe, in sweltering deserts and jungles, mountains, plains and veldts, in invasions and evacuations, in headlong retreat, in static warfare, in precipitous advance; from battlefield to hospital sometimes a matter of an hour or two, over good roads or perhaps a trek of three weeks over a roadless waste—in practically every conceivable condition and climate. Each campaign has taught something new, but every apparent surgical advance has had to be tested under all these circumstances, for, without these controls, no innovation in war surgery can be accepted as an advance. Few of these world-wide opportunities came the way of any other nation, it was Britain's task and a task very much after Britain's heart.

It is also the tale of the evolution of weapons and missiles. Had there been an embargo on the development of weapons of destruction, we might be less able to alleviate suffering, but there would not now be a world of preventable suffering to alleviate. On the other hand, surgery, military and civil, would not have advanced at the speed it has.

In the South African War *the* missile was the high-velocity bullet. A good deal of concern was expressed about the possibility of blunt-nosed and expanding bullets being used—missiles which were not quite cricket; happily it could not then be foreseen what the future held in store. Explosive shells were used, the proportion of bullet to shell wounds being about nine to one, but their effects were not greatly feared; shrapnel shells were often made to burst very high and cause little damage, in fact the eye witnesses of the day referred to the attendant noises as the most unpleasant feature of rapid shellfire; happily again they could not foresee what their sons and grandsons would be called on to endure. The campaign was a little unfortunate from the surgical point of view, the bullet was about half the size it had been in former wars, it did not tend to carry in clothing, and inflicted small wounds and tracks which rarely caused serious trouble wherever placed; there were plagues of flies but the

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veldt was about as sterile as a desert. Had subsequent wars been fought under the same conditions, the surgery of the South African War would have formed a valuable precedent, as it was it merely gave a false sense of security.

The surgery of that campaign is largely forgotten, that of later wars is not: it is of value therefore to recount briefly the methods practised at the opening of this century. They may give a better impression of how time has marched on since then.

On the battlefield a first field dressing and sometimes an antiseptic paste were applied to the wounds. At the Field hospital there was thorough cleansing of the surrounding skin and wound, which was dressed with double cyanide gauze.

Compound fractures were treated conservatively when the wounds were small but were explored early and bone fragments removed when the exit wound was large, the wound being left open without drains or plugs unless there was frank infection. Internal fixation by screw or wire for oblique fractures was considered justifiable. Immobilization was effected by plaster of Paris, wire and wooden splints; a cane folding splint was popular for thigh and leg fractures during transportation, but Hodgen's splint was in use in hospitals. Fractures of the femur were regarded as the most formidable of limb wounds, 15–20 per cent required amputation at the base and the overall mortality was around 15 per cent. Most serious fractures were held for three to four weeks before transfer to the Base, the rule being that no fractures of the leg and thigh, and few of the arm, could be transported for any distance without serious trouble developing.

Joint wounds were not a problem; on simple expectant treatment suppuration was rare and functional results were excellent.

Deaths from external hæmorrhage were unusual but, as one would expect, traumatic aneurysms were common and progress was made in the study of vascular injuries in war. Cases severely shocked were treated in the supine position with strychnine and pre-operative saline infusion. The merits of chloroform as an anæsthetic were extolled. Removal of foreign bodies was performed at Base hospitals; in localization, X-rays had replaced the probe.

Operations were avoided if possible in the Field hospitals, except amputations and for head wounds. When operations were considered necessary the importance of their being performed early was well recognized, and a very high priority was given to head injuries—all skull splinters, and all pulped brain which would wash away were removed, the scalp was closed without drainage, primary union being regarded as of first importance.

Penetrating bullet, shell, and shrapnel wounds of the chest all did remarkably well. Hæmothoraces were tapped to relieve pressure, but the usual course of all was to spontaneous recovery and empyema was regarded as a sequel to tapping or opening. Adhesions were the rule and it was customary to invalid all chest wounds because they suffered breathlessness on exertion and pain. There had been great expectations of advances in the treatment of abdominal wounds: as it turned out there was only disappointment. Small calibre bullet wounds of solid viscera presented no problem and it was known that a certain

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proportion of intestinal wounds recovered spontaneously. Apart from that at the end of the campaign it had to be confessed that operative surgery had scored but few successes. An eminent consultant recorded that he had met no case of recovery following visceral injury due to a large bullet. This failure was attributed to the severity of the local injury and to the fact that cases came to operation too late. Serious lesions of the small intestine appear to have been even more feared than those involving the large bowel, which were considered to have a greater tendency to become sealed off by adhesions and form a circumscribed abscess amenable to surgery, the whole process being doubtless life-saving as a colostomy. There were successes but operative treatment was so disappointing that the policy became one of hoping for spontaneous recovery, watching rather than operating, excluding from operation all cases likely to die early, and expecting a fatal result from operation. Yet the opinion expressed at the close of the campaign was that severe injuries should have operative treatment, and that it would be from this class of case that the real successes of the future would be drawn. Makins describing his experiences with the wound involving the posterior aspect of the colon, concludes: "In the future I should always feel inclined to enlarge such wounds and bring the bowel to the surface"—a prophetic remark which if acted upon might have altered surgical history earlier, and might have compensated for the other disappointments.

That briefly is the story of the surgery of the South African War; it was a campaign of slow evacuation, with stretcher bearers easier to obtain and feed than transport animals, it was the day of the covered wagon, yet surgeons dreamed dreams of the days of mechanization, foreseeing a great future for the traction engine. "Traction engines were so far as known, never employed as a means of transporting the sick, the tendency of these machines to stick in the mud and break down bridges is well known but putting these disadvantages aside, with a supply of fuel ensured, and such roads as are afforded by a civilized country, a great future is probably before this means of transport for the wounded. A large number of patients might be carried at an even pace, and the camps saved all the trouble and worry of the transport animals."

There followed a decade of peace. The Surgeon General at the College attempted to compile the surgical history of the war and his comments are illuminating. He complained that from stress of work, surgeons had little time to indulge in note taking, that of the 23,000 wounded officers and men who passed through the hospitals, case notes of only 1,650 were of any surgical interest. He complained of looseness in diagnosis—"gunshot wounds," giving no site, "gunshot wound of leg," giving no indication of fracture—and considered that the solution was a card system for each patient from the time of wounding and the establishment of a statistical bureau at the base; all good advice for the future. History goes on repeating itself.

Following the war, the civilian surgeon stored his uniform, and the regular Army surgeon returned to his peaceful pursuits, caring for the soldier and his family wherever they might be, not always in unpleasant places, Canada and South Africa were still on the foreign service list, while service in unhealthy lands still counted double. The Professor at the College taught military sur-

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gery of 1901 pattern. If he had concentrated on a two-word slogan "early treatment," he would perhaps have epitomized the lessons of the previous war. New editions of the books published after the South African war appeared in 1913 and were regarded as the last word on the subject of military surgery. The very last year of real peace drew to a close, and the present writer emerged one fine evening in 1914 into St. Martin's Lane from seeing Gaby Deslys in *Rosy Rapture,* to find on the newspaper placards in screaming headlines "England Mobilizes." Shortly afterwards he was receiving the first cases from the battlefields at a home hospital, and a little later had charge of tetanus cases in a military hospital. From *Rosy Rapture* to "tetanus" describes the transition from war to peace in 1914 and the realization that the clean perforation of a rifle bullet in a pastoral country, was one thing, and the mutilations by new missiles in the heavily cultivated fields of Flanders were something shatteringly new.

In the early days medical units were swamped by the deluge of wounded, over 54,000 in 1914; 206,000 in 1915 (38,000 from the battle of Loos alone): while the cost in casualties of the first two days of the battle of the Somme was 58,000. The total number wounded in France and Flanders alone was 1,988,969, a frightful problem, especially in the early days of first impact.

The weapons of this war were the machine gun, capable of concentrated fire at the rate of 400–500 shots a minute instead of the rifle's 20 odd, inflicting more severe injuries than any previously seen in war; high explosive shells causing 73 per cent of casualties under static warfare conditions, with greater danger of infection, and twice the fatality of bullet wounds. Mortars, grenades, aircraft bombs and land mines completed the list.

Worse than the numbers were the infections and the frequency of anaerobic contaminations. Gas gangrene had been comparatively rare before the war and very rare in any previous campaign. In No. 1 C.C.S. in 1915 the incidence was assessed at 5 per cent of the wounded, while the incidence of tetanus in the Army in France in September 1914 was 8·8 per 1,000. Bullets carried in infection from filthy mud-soaked garments as never before, and shell fragments carried in pieces of the garments themselves.

In the Mons retreat in 1914 there was no possibility of early surgery and even when the line became stabilized, the problem was such a vast one for a Medical Service unprepared for such eventualities, that there could be little organized early surgery until the spring of 1915, while in battle periods throughout the war, the influx of wounded was so great that early treatment was generally a counsel of perfection, and something under twenty-four hours' time lag before operation was as good as could be hoped for. The Regular Army had been decimated in the retreat, what remained and took its place spent the next three years underground. Enveloped in a sea of mud each winter, suffering from frost-bite and trench-foot—about 20,000 cases a year—trench fever and all the other ills, not to mention horrors associated with trenches and dugouts, chlorine, phosgene and mustard gases added to the weapons of destruction they had to fight against, their expectation of life during battles a matter of minutes, and maiming their only hope of release, what degree of resistance

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to severe infection could these men have had? They were to talk in a later war of the men in a famous Army as "every man an emperor," it would be fair to talk of these 1914–18 men as "every man a man, whose like we shall not see again."

A few landmarks in the 1914–18 War are all that space permits. Surgeons had expected cases to behave benignly and were quite inexperienced in the treatment of infections more severe than any seen since the days of Lister. Surgical facilities in the forward area were quite inadequate. All operations had to be done at the Field Ambulances and they were unable to cope with the situation. Not until the end of 1915 did the role of the Field Ambulance become limited to securing rapid evacuation, preventing shock, and performing those life-saving operations which are still that unit's responsibility to-day. First-aid treatment, far more often than not, was all that was possible, the application of antiseptics at the time of wounding was soon omitted as it did nothing to prevent infection and initial treatment was limited to applying the first field dressing.

Fractures at the start were immobilized in wooden splints, the internal angular and Gooch's for the arm, the back splint with foot and side pieces for the leg, and the long Liston for the thigh. Those who remember the Liston splint will understand the mortality rate of nearly 50 per cent in fractures of the femur, the journey shocked these cases to death. By the end of 1915 the Thomas knee splint was in use in Base hospitals and in another year was in general use in forward areas. Its introduction halved the mortality in fractures of the femur. It was and is the most valuable first-aid invention in war surgery. The wounded soldier with his femur smashed owes a very great deal and often his life to Hugh Owen Thomas.

Motor ambulance cars had been rushed out for the battle of the Aisne in September 1914, motor ambulance convoys were becoming more organized, and with the appearance of a new unit, the Casualty Clearing Station, real steps were taken to bring surgery to the wounded and cut down the period of dangerous delay. From small beginnings these units increased in size, equipment, and personnel, so that by the time of the Battle of the Somme, the Fourth Army had fourteen of them, and also an advanced operating centre. Some of these C.C.S.s had 1,000 beds and on the first night of the battle were housing 1,300 patients. They were intended to be mobile units but had a tendency to develop such elaborations in equipment, as almost to immobilize them.

Until then the days had been grim indeed. Surgeons, mistakenly perhaps, had concentrated on antiseptic attack on the infections. Mercurials, pure carbolic, lysol, formaline, salt packs, BIPP, eusol—all were tried and sometimes showed some promise; the Carrel-Dakin method did have success, for in addition it did achieve very thorough drainage. For many months wounds closed or inadequately drained reached the Base in a terrible state, while those adequately opened up arrived infected but in reasonably good condition. It took time to elaborate the principles of excision of all contused and lacerated tissues and the removal of all fragments of clothing and foreign bodies but it was this

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policy that dealt a real blow to infection and was the most potent factor in the prevention or arrest of gas gangrene.

The suture of wounds, catastrophic in the early days, happily fell into disuse for a year or two, but with the development of adequate preliminary surgery was safely revived and, by the end of the war, cases untreated for as long as forty-eight hours were being closed by primary or delayed primary suture. Some series showed 88 per cent successful closure even when surgery had been delayed for forty-eight hours, others 95 per cent successful when operation was within twenty-four hours.

For the first time in war, orthopædic centres were established with far greater continuity in treatment, physiotherapy and rehabilitation. Limbs previously doomed were saved, while men who formerly would have been completely incapacitated with stiff and useless limbs returned to fight or to do useful work in industry.

By 1917 shock was being tackled systematically on the same general lines as at present. When an infusion was considered advisable gum was preferred but blood transfusion was being practised by various methods, the citrate method being accepted finally as superior. In that year transfusion officers were giving blood in selected aid posts. The art was in its veriest infancy, of value at times of no great activity, but not organized for mobile warfare with heavy casualties.

Chloroform was the only anæsthetic made available at the start. Warm ether vapour, and gas and oxygen replaced it with happy results. Anæsthetic specialists appeared for the first time in 1916; two hundred nursing sisters gave anæsthetics skilfully in 1918, freeing doctors for front-line work.

As in other situations, wounds of the chest followed a sadly different course from that of previous campaigns or contemporary campaigns like that of Palestine, the more modern missiles causing greater damage, and the soil greater risk of infection, anaerobic and streptococcal. In 1914–15 the mortality rate in cases reaching medical units was nearly 30 per cent and, when infection occurred, 50 per cent died. At the start the fear of pleural reflexes and of re-starting hæmorrhage deterred surgeons from attempting any really cleansing operations. Infection was dealt with by simple rib resection and drainage—life saving in some, but with crippling after-effects in a proportion of those recovering. It did not take long to discover that aspiration of a large hæmothorax on the first or second day did not have untoward effects and this discovery had some result but it soon was realized that wounds of the chest must be dealt with as were wounds elsewhere. By 1917 thoracotomies were being performed on 38 per cent. of all chest wounds, the parietes, pleural cavity and lung being dealt with, but the results to the end of hostilities were somewhat disappointing.

Especially in the case of abdominal wounds did the shadow of South Africa obscure the paths of progress. For a year, in all the Armies, expectant treatment was the rule. Care was lavished on the wounded abdominal case but the patient nevertheless died slowly, without benefit of surgeon. It became evident that hæmorrhage was so commonly a cause of death, and the visceral

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injuries were so extensive, that nothing short of operation could be of any avail. Operative therefore replaced expectant treatment and by the time of the Battle of Loos in September 1915, abdominals were given the highest priority in evacuation to C.C.S.s and advanced operating centres. Before this policy was adopted over 80 per cent of abdominal wounds died. When, however, early surgery was the policy, the overall mortality was over 50 per cent; of small intestine wounds 65·9 per cent died; of large intestine wounds 58·7 per cent died. These figures do not denote any additional risk from colostomy but the interesting fact emerges that in the first world war there was greater danger of death from colonic wounds subjected to colostomy (73·5 per cent), than in those sutured (just over 50 per cent), and the danger was greater in both instances than in the phase before early surgical intervention was general (38·7 per cent). Delay and infection, dangerous in other wounds, were deadly in abdominal wounds, and the problem of the infected retroperitoneal tissues, often fulminating anaerobic, was a terrible one. Operation too long delayed merely spread an infection which Nature had been striving to localize. Considering all the difficulties which in these short paragraphs have only been hinted at, the results were on the whole gratifying. At best, the most immaculate surgery was a gamble against time and death on a patient who, by later standards, was nearly always insufficiently resuscitated, too often hopelessly so.

The treatment of the wounded did not end with the close of hostilities, the aftermath of a war of chronically infected wounds was a periodic breaking down of these wounds and shedding of sequestra for years to come.

Following the war of 1914–18 many of the civilian surgeons stored their uniforms, but many chose to make their career in the Regular Army—an estimable thing for the Army which thereby gains a leavening or, perhaps, a transfusion. The professor of military surgery at the College resumed his teaching, epitomizing the lessons of the previous war in the three word slogan "early thorough surgery."

The Regular Army surgeon returned to his peaceful pursuits for the next twenty years, spending much of his time in foreign parts, for in these days a foreign tour was not a protracted cruise, but an unbroken period of five years or more, and a home tour little more than a longish visit. These peaceful pursuits were not, as is sometimes believed, a round of shooting and fishing with occasional interludes of mild work. On the contrary there was not much time to spare if a fair surgical deal was to be given to the soldier and his family and many others in a parish of some 350 miles radius. The surgeon often found himself driving that distance in tropical heat that seared the eyes, to an operating theatre with no air-conditioning where two emergency operations might be just possible, but three might be too much for him; or operating at sea on acute abdomens, off Algiers, off Sierra Leone, off Port Sudan, amputating a thigh for gas gangrene in a gale in the Bay of Biscay; or crawling on hands and knees to yet another emergency in a typhoon in China; journeying 2,000 miles to graft a bone; operating on the wounded in a perimeter camp in the heart of the frontier of India, early in the day before the awakening of the black ceiling of flies. All surgeons must have motley memories of these

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years of peace, memories of shark bites, snake bites, camel bites, rabies, tiger maulings, violence of every description, the usual and unusual in tropical and traumatic surgery in addition to general, gynæcological, and obstetrical surgery as at home; memories poignant, for the Army surgeon must be guide, friend and parent to the soldier in his loneliness, sick unto death, far from home; memories bizarre—the gratitude of a villager, when a Winett-Orr treatment on his pregnant cow's old compound fracture has been blessed with success; the satisfaction of earning a pair of Jodhpur breeches in payment for a resected colon.

In all the peace years, however, the surgeon is merely holding the fort, preparing for war, organizing according to the lessons learnt in the last war, against the day when the alarm will sound and the civilian surgeons return: for the surgical service of the Army is not alone the Regular Army but comprises all those who stay in, and those who come, and go, and may return.

The war of 1939–45 is too recent history to require much comment. In many and varied campaigns, the surgical doctrines of 1918 have largely been verified and largely amplified, and there does not appear now to be so much to learn as to apply. Very many factors—early adequate surgery; the wounded man's increased ability to stand whatever operative treatment was necessary and his greater resistance to infection later, which result from full resuscitation; the "adjuvance" of penicillin to thorough surgery; the determination of all concerned to close wounds by suture of graft within a matter of days of their infliction; the increased knowledge regarding when to hold cases, and the military situation which permitted holding and good nursing; the victorious atmosphere with its psychological advantages and lessened risk of treatment centres being bombarded by gunfire or bombing—these and many other factors in the terminal triumphant years have been conducive to wounds behaving in an orderly fashion as regards infection, anaerobic and otherwise.

No miracle, however, has occurred, there is no diminution of bacteriological virulence in Flanders fields as has occurred in the case of malaria in Macedonia. One had only to visit the German wounded in their own hospitals and see the trays, collecting pus pouring from the wounded limbs of toxæmic wrecks, to realize that when everything in a campaign is going according to plan, when surgeons are expert and *all* they require is provided, the care of the wounded of that campaign is of the nature of a triumphal march. This country bought dearly its knowledge of what happens in all other military circumstances and, in all future planning, the other side of the picture must never be forgotten.

In this latest war, all the old terrors reappeared and all manner of fiendish new weapons were introduced, including new varieties of land mine, which typically tear a limb off. *The* weapon of the war, however, was the aeroplane, and *the* missile the bomb, increasing in size and virulence until the atomic variety added radiation blast injuries as a new and devilish destructive force.

In the years between the wars the question of mechanization had loomed large in all military medical discussions. It can be said that the forward units in their collection and evacuation to the surgeon, have met the surgeon's demand for speed. For the immobilization of limbs, plaster of Paris and the Thomas' splint are now considered to be sufficient, the former applied so as to

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avoid all constriction has been satisfactory for severe flesh wounds and arm and leg fractures, while both have been combined in the Tobruk plaster to give immensely improved immobilization to the thigh fracture during a prolonged journey.

The history of the organization of blood transfusion is recorded elsewhere. Perhaps the most striking advance has been in resuscitation, the excellence of which has been reflected in the recovery rate of seriously wounded men whose blood loss has been severe. The fact that a wounded man has blood returned to him as fast as he bleeds, has made surgery reasonably safe for the gravely wounded, while those desperately injured, even the apparently moribund, are no longer doomed. Mention should also be made of the progress of resuscitation of the severely dehydrated wounded and burned whose need for fluid replacement has sometimes to be reckoned almost in gallons rather than pints.

In anæsthetics as in so many subjects allied to surgery and in war surgery itself, there may have been few real innovations, but war has given an impetus to the much fuller development of existing ideas and has passed on that impetus to civilian surgery. The intravenous administration of barbiturates as the sole or initial method became by far the most frequently employed anæsthetic in the later years. It has been the greatest help to the surgeon, and an inestimable boon to the wounded bringing them immediate tranquillity and relief, instead of a bludgeoning into unconsciousness by the methods of the past. It can be said that the elaboration of this speciality in this war has made possible most of the operative advances, especially those connected with thoracic and thoraco-abdominal wounds, and has removed the "no thoroughfare" noticeboard from the transpleural route.

The treatment of chest wounds has progressed apace. The policy of concentrating on the return of lung function by dealing adequately with the hæmothorax, the prevention or treatment of the complications of hæmothorax and the rehabilitation which accompanies these measures, should pay good dividends in the after-years of these cases. The war has demonstrated the importance of the physician in the chest team, and the value of the chest centre after the patient has had his first few days of preliminary treatment forward.

Abdominal wounds which previously showed a mortality rate at around 70 per cent, now show a recovery rate at that figure. No new surgical measure is responsible but the principle of exteriorizing wounds of the distal half of the colon, and the proven ease of the thoracic approach to the upper abdomen, have been of vast importance. In the post-operative treatment, during the week in which the patient must be held before transfer, many life-saving measures have become routine. Suction decompression must be held to have played an important part in the prevention of paralytic ileus, and Fowler's position appears to have sagged into the horizontal with beneficial rather than untoward results, but the surgeon who uses it correctly and reasonably in frankly infected cases is not necessarily wrong in his beliefs.

War gives a magnificent opportunity for controlled tests, and the best example is that of the evaluation of penicillin. With preliminary adequate surgery

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to eradicate damaged tissues cut off by trauma from the circulation, penicillin has bettered the outlook for wounds in general, has played an important part in the treatment of joint and chest wounds, and may have done much to prevent the chronic osteomyelitis which used to be such a feature of the years following a war. One lesson that may fairly be claimed to have been learned is that no therapy, using any of the known antibiotic or chemotherapeutic agents, gives any excuse for neglecting the principles of sound war surgery learned in the hard schools of two world wars.

In the treatment of wounds of the heads at neurosurgical centres there have been notable advances, reducing the mortality rate from nearly 50 to 10 per cent, but space does not permit further details, even to describe the highly satisfactory set-up of the specialized centres—neurosurgical, orthopædic, thoracic, vascular, plastic. Conditions were favourable for the success of these units and they are adaptable to different conditions.

It is a far cry from the covered wagon to air evacuation. Six times the total number of wounded in the South African war went by air to home hospitals from the battlefields of the final campaign in France and Germany. The possibilities of air evacuation—by medical air ambulance convoy—are still immense and range from long-distance evacuation of wounded in large numbers by fast aircraft to picking up wounded survivors from a cut-off armoured or other force, using highly manœuvrable planes of the helicopter type.

Since 1945, commitments grow less, but the size of the Army is still too large for the small regular R.A.M.C. to be responsible for its surgical service unaided. For three years the R.A.M.College has concentrated on the training of specialists, those who by reason of the war have been called away to duties unconnected with their speciality, and those who must now or never become more highly qualified. Their successes in obtaining higher diplomas have been a most hopeful augury for the future. The senior and specialist course can now be a year longer than it used to be. Civilian teachers throughout the country give most generous help in special branches of surgery and registrar types of appointment are made available. The wartime consultants, on occasions, lecture at the College. Their friendly help, unstintingly given, as always in the war, is another very happy augury for the difficult future.

With the appointment of colonel consultants in overseas commands, a full Army career in surgery is now possible, and the very legitimate grievance that an Army surgeon, with valuable experience, had to give up the practice of his speciality quite early in his service, has been met.

It is well that at one centre in the kingdom, war surgery should continue to be taught. The lectures at the R.A.M.College are now of 1945 pattern, but that there may be no false sense of security arising from the surgical triumphs of the victorious terminal years of the war, the appalling problems encountered in the earlier years are studied. Atomic warfare, although its lesions do not belong so much to the domain of surgery, now has to be included in the curriculum, for the fifty years of wars draw to a close, still with rumours of war.

Those who have taken part in the military surgical events of this half-

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century, during which wellnigh the whole of the history of war surgery has been written, have the great honour to belong to an era which will be unique for all time. Posterity may judge them to have been "faithful," it surely must hold that their duties were "arduous."

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THE TREATMENT OF VENEREAL DISEASES IN THE BRITISH ARMY – 1898-1948

BY

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In a survey of the treatment of venereal diseases in the British Army covering the period 1898 to 1948, it is impossible in a single article to point to more than the main therapeutic developments occurring in this half-century, commencing as it does in what are the early years of venereology as we know it to-day, and terminating in the penicillin era. For it must be remembered that it was not until 1838 that it was generally accepted that syphilis and gonorrhœa were two entirely separate diseases, and the gonococcus was first described by Neisser in 1879. And it was only in May 1905, that Schaudinn and Hoffmann first described the *Spirochæta pallidum,* and one year later (1906) that Wassermann, Neisser and Bruch developed the test for syphilis which now bears Wassermann's name, and in 1909 that Ehrlich discovered arsphenamine ("606"). In 1911 Noguchi cultivated the spirochæte of syphilis *in vitro,* and he also confirmed the syphilitic origin of general paresis of the insane, which had hitherto been classified as a parasyphilitic disease, by demonstrating the organism in the cerebral tissues.

The diagnosis and treatment of venereal diseases has always formed an important part of Army medicine—especially so in the past. Speaking of the early part of this century, one Army venereologist went so far as to say, "some 30 per cent of all diseases in the British Army are due to venereal complaints" (French, 1908). The last fifty years has seen many advances in the treatment of venereal diseases, and also an awakening of the public conscience. However, it cannot be gainsaid that the Army Medical Service has played a very important, and often pioneer, part in many of the advances which have taken place. As Colonel Lambkin stated in 1908, "syphilis is treated in the Army not only with the view of relieving its present manifestations, but also of preventing further trouble, and bringing about a cure of the disease itself," a policy not universally recognized, especially at this time.

It is proposed to consider only each of the main venereal diseases, tracing the evolution of treatment from the beginning of the period to the present year, attention being mainly confined to the diagnosis and therapeutics of early disease. The administrative and prophylactic problems associated with venereal diseases, and consideration of the later manifestations, are subjects on each of which an entire paper could be devoted.

Syphilis

To those of us brought up on such methods of diagnosis as dark-ground examination and blood tests, it seems almost unbelievable that for the first seven years of the life of the Royal Army Medical Corps, the causal organism

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of syphilis was a matter of conjecture, and that diagnosis could only be made from the clinical appearance of the sore, and the subsequent course of the disease. Contemporary opinion, both civil and military, was divided as to whether the character of the sore alone was sufficient for a certain diagnosis, or whether treatment should be withheld until a local or generalized adenitis occurred, or cutaneous manifestations and general constitutional disturbances became apparent. In this connexion, it is interesting to note that even early in the present century, it was generally held in the Army that treatment, once embarked upon, must be continued until the full course was completed, and that in the early stages treatment should be carried out in hospital to avoid contagion. The mainstay of treatment was mercury in one form or another—mercurial therapy is believed to have been first used for syphilis by Jean de Vigo in 1497.

" The Army Medical Department Report for the Year 1897 " in an appendix publishes recommendations for a modified form, for the treatment of soldiers, of the Aix-la-Chappelle system of treatment of syphilis (Dick, 1897). The scheme recommended was as follows:

"1. Every morning the soldier is to take a hot bath at a temperature of 90° to 100° F., into which a handful of ordinary washing soda has been thrown. He should sit in this bath up to the neck for half an hour.'

2. Immediately after the bath, 1 to 2 drachms of an ointment (made by adding and mixing well 2 lb. of the ung. hydrarg. of the British Pharmacopœia and 1 lb. of lard), to be rubbed in daily, the parts of the body each day being (*a*) legs; (*b*) thighs; (*c*) back; (*d*) chest: (*e*) arms. The rubbing to last for twenty minutes, syphilitic patients being taught to rub each other.

3. A gargle and mouth wash of one ounce of alum to the pint of water; a table-spoonful of this in a glass of water to be used every hour—and the teeth and gums to be brushed after each meal with camphorated chalk. Should the gums become tender they should be painted with a mixture of tincture of galls and tincture of myrrh in equal parts.

4. The treatment to be stopped for a few days on the appearance of mercurial symptoms.

5. The treatment to be carried out for a month, the same underclothing being used the whole time.

6. Ulcers about the mouth, or throat to be touched with a 10 per cent solution of chromic acid.

7. The whole treatment must be carried out under strict supervision."

The author concludes by stating that if taken sufficiently early, the later severe manifestations of constitutional syphilis would in all probability be prevented by this regime. He also gives an account of a visit to Aachen, and after stating that the whole treatment can only be carried out in its entirety at Aachen itself, where the necessary spa facilities exist, concludes that " it is therefore probable that the well-to-do sufferers will always go to Aachen and so far as the Army is concerned, I think I should always recommend officers to go there who had been unfortunate enough to contract the disease."

On October 20, 1905, a series of most interesting and voluminous reports were published by a Committee convened by the Advisory Board for Army Medical Services to inquire into the treatment of venereal disease and scabies.

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These reports include extracts from contemporary literature, and opinions expressed by experts (both civil and military), on all the aspects of prevention and treatment of venereal disease, together with recommendations for treatment. On the recommendation of the Advisory Board these reports later formed the basis of a textbook on the diagnosis and treatment of venereal disease, by Lieut.-General Sir Alfred Keogh, *K.C.B.*, D.G.A.M.S.; Colonel C. H. Melville; Lieut.-General (then Lieut.-Colonel) Sir William Leishman, and Major-General (then Major) C. E. Pollock. A later edition published in 1913 had additional matter by Colonel (then Major) L. W. Harrison. The Committee was unanimously in favour of the administration of mercury in some form over a period of eighteen to twenty months in the treatment of syphilis, and it expressed the opinion that the results of the then known forms of non-mercurial treatment in every case appeared to be unsatisfactory. They described the two main methods of giving mercury as the continuous method, consisting of a course of mercury for a definite period continuously, or with short interruptions only; and the intermittent, in which the treatment is given for set periods with longer intervals between. Evidently, early in the present century, the usual treatment of syphilis consisted of oral mercury in the form of either grey powder, blue pill, the green iodide, etc., in pill form, or solutions of the perchloride or biniodide, usually in alternating courses with potassium iodide by mouth in the intervals.

A typical course consisted of the following, using a pill containing grain 1 hydrarg. cum creta:—

	Months	*Pills*
First course:		
One month, taking 6 pills a day	1	180
Interval of three days without pills	—	—
One month, taking 4 pills a day	1	120
Interval of seven days	—	—
One month, taking 3 pills a day	1	90
Interval of one month	1	—
Second course:		
Three months, taking 3 pills a day	3	270
Interval of one month	1	—
Third course:		
Three months, taking 2 pills a day	3	180
Interval of one month	1	—
Fourth course:		
Three months, taking 1 pill daily	3	90
Interval of three months	3	—
Fifth course:		
Three months, taking 1 pill daily	3	90
	21	1,020

Patients were inspected one a week while under treatment, particular attention being paid to the mucous membranes of the mouth and tongue, and it was advised that the effect on each individual be carefully watched, and the treatment varied to suit each case. After the third, fourth, and fifth courses, a short course of potassium iodide, 15 - 30 grains daily, was recommended.

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Also in common use in military hospitals at this time were schemes of treatment consisting of courses of intramuscular injections of the soluble salts of mercury, such as perchloride of mercury. These were given three times a week owing to their rapid excretion, each course being of six weeks' duration.

Mercurial inunction similar to the modified Aachen method previously described was in common use. This treatment was continued over a period of nearly two years as follows:

	Months	*Grs. Hg.*
First course:		
42 daily inunctions	1½	840
Interval of three months. Patient to be seen once a fortnight	3	—
Second course:		
42 daily inunctions	1½	840
Interval of three months. Patient to be seen once a fortnight	3	—
Third course:		
30 daily inunctions	1	600
Interval of six months. Patient to be seen at regular intervals	6	—
Fourth course:		
30 daily inunctions	1	600
Interval of six months. Patient to be seen at regular intervals	6	—
Fifth course:		
20 daily inunctions	⅔	400
	23⅔	3,280

However, the Committee of the Advisory Board for Army Medical Services, in their Final Report, concluded that far and away the most effective and foolproof method of treatment was by means of intramuscular injections of an insoluble preparation of mercury into either the gluteal or deltoid regions. A "depot" being formed from which mercury was slowly absorbed. The following cream, introduced into the British Army by Colonel Lambkin in 1890, and stated to be in frequent use was recommended:

℞ Hydrargyri ... ... ʒ i
Adipis lanae (B.P.) ... ... ʒ iv
Paraffini liquidi (carbolisat. 2 per cent) ... ... ad ʒ x

The mercury and the wool fat by weight, the liquid paraffin to be added by volume.

Ten minims of this cream contain one grain of metallic mercury.

The Committee, while making it clear that no hard-and-fast rule can be laid down to suit every case, considered that the following course then in routine use at the Military Hospital, Woolwich, was the average treatment required "to cure the disease and to permit of the soldier fulfilling his contract with the State," and "likely in the majority of cases, to be an improvement on the plan of giving mixtures or pills to the patient and leaving them to be taken or not at his own convenience."

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Six weeks' treatment, 6 injections	grains 9 of mercury
Two months' interval with medical inspection every fourteen days. If signs recur during interval repeat six weeks' course and then give two months' rest	
Two months' treatment, 4 injections	grains 6 of mercury
Four months' interval with medical inspection every fourteen days. If not free from signs of the disease, decrease interval to two months.	
Two months' treatment, 4 injections	grains 6 of mercury
Six months' interval.	
Four months' treatment, 4 injections	grains 6 of mercury
Total, 21½ months' treatment, 18 injections	grains 27 of mercury

The Report also expresses several opinions which mirror the unsatisfactory state of diagnosis and treatment early in the century. Examples of such are the statement that hot mercurial baths are of value in patients suffering from multiple ulcerated, and necrotic syphilitic lesions, who are also debilitated from other causes, such as tropical service, prior to the commencement of other forms of treatment, also the recommendation that "the employment of surgical treatment by the removal of bony sequestra or other necrosed tissues and various plastic operations should be utilized with discretion." Mercury vapour baths were used in the treatment of selected cases for many years. Also a regime of treatment known as Zittmann's treatment was used in "malignant cases, where the patient is debilitated and will not bear mercury when prescribed by any of the commoner methods." This treatment consisted of keeping the patient on a light diet in a room at a temperature of 80° F. to promote sweating, for fifteen days. During this period he takes mercury in minute doses in pills, and in hot decoctions, a half-pint eight times a day—it was suggested that "smaller quantities may have to be used at first as the mixture is rather nauseating." Special rooms for carrying out this form of treatment were constructed in certain military hospitals, e.g. the Military Hospitals at Rochester Row, London, and Woolwich. Great stress at this time was laid on the building up of debilitated patients by means of diet, e.g. milk, eggs and port wine (French, 1908).

Attempts had been made from time to time to render painless the treatment by means of the insoluble salts of mercury, by incorporating various local anæsthetics into the preparations used. This was especially necessary in the case of calomel. In 1907 Colonel F. J. Lambkin published reports of two types of mercurial cream, which were later extensively used in the Army (Marshall and Ffrench, 1921), and which he stated were more effective than the original, and almost painless in use, even in the case of calomel. The formulæ of these were as follows:—

Hydrargyrum pur.	10 grammes
Creo-camph. (Equal parts of absolute creosote and camphoric acid)	20 c.c.
Palmitin basis	to 100 c.c.

10♏ equals metallic mercury grain 1

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Calomel	5 grammes
Creo-camph. (Equal parts of absolute creosote and camphoric acid)	20 c.c.
Palmitin basis ... ... to	100 c.c.

10♏ equals calomel grain ½
Melting point, 37° C.

The pages of both contemporary civilian medical journals, and those of the Journal of the Royal Army Medical Corps during the period 1903–10 contain many papers and letters, sometimes acrimonious, dealing with the merits and demerits of the various forms of mercurial treatment, showing that no uniformity existed. Certain Army venereologists were of the opinion that intramuscular injections were ineffective as compared with other methods of administration such as inunction, or that the former were painful and caused patients to refuse this form of treatment. For example, Major H. C. French, R.A.M.C., writing in the *British Journal of Dermatology* (November–December 1908) as regards early syphilis, expressed the following opinion: "I am fully convinced that both the mouth and inunction methods of administering mercury in suitable and average cases are infinitely preferable as regards curative action on syphilis to the injection of insoluble salts, such as grey oil." It is further pointed out that patients receiving inunctions "use condemned hospital flannel underclothing, which is changed once a month and then destroyed—so the cost is very slight."

As regards follow-up and post-hospital treatment, it was not until 1903 that an Army Order (No. 158 of September 1903) was published, ensuring the attendance of "soldiers not requiring hospital treatment" for out-patient treatment and observation. This was later embodied in King's Regulations and R.A.M.C. Regulations (French, 1908). As regards documentation, a permanent records and statistics scheme was introduced in January 1904: "Instructions Regarding Procedure in Cases of Syphilis." This was later embodied in Regulations for the Army Medical Services.

So unsatisfactory was treatment by means of mercury, that often it was questionable which was worse, the ulceration due to syphilis or that of the mucosæ due to treatment. Attention to oral hygiene, removal of stumps, and the regular use of an astringent mouthwash, and the touching of ulcers with 10 per cent chromic acid followed by silver nitrate, and attention to the general health and well-being of the patient were all a very necessary part of the mercurial treatment regime. Sarsaparilla and iodides were also used to help in the elimination of mercury from the body, the latter also being prescribed in gummata and periosteal lesions, and in order to prevent the onset later of parasyphilis (French, 1908). One Army venereologist, later recalling the effects of this form of treatment, wrote as follows: "Picture the cases long treated by mercury; the debilitated condition, the frequent and distressing diarrhœa, the loss of weight, the ulceration of the mouth, the stomatitis, the loosening of the teeth, the foul breath, the intense salivation and the feeling of sheer misery which many of these patients developed. The physicians were satisfied, for their cases were said to be mercurialized. The patients were not, for they preferred the disease which was painless to the treatment which was painful.

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The wealthy in their hundreds moved to Aix-la-Chapelle and consumed gallons of sulphur waters, the poor in their thousands remained at home and endured the misery of their condition with such philosophy as they could command" (Clarke, 1933).

It would not be out of place here to consider the developments in the diagnosis of syphilis which occurred during the early part of the present century. As has been already pointed out, it was not until 1905 that Schaudinn discovered the *Spirochæta pallidum,* and even then, this was at first discounted from the point of view of its clinical utility by the extreme difficulty of demonstrating the organism, and clinical appearances were considered by many to be of more diagnostic value (French, 1911). Later, the staining methods of Giemsa, Leishman and others, and silhouette methods using Indian ink, etc., made diagnosis somewhat less hazardous. But the situation remained much the same until the examination by dark-ground illumination became a practical proposition. In May 1910, Colonel L. W. Harrison describing this advance, and reviewing the literature, concludes: "By its means and that of the Wassermann reaction, the treatment and general management of syphilis will become a much more exact science than heretofore, and the importance of both to the Army cannot be over-estimated."

Arsenic in such forms as Donovan's solution (liquor arsenii et hydrargyri iodidi) by mouth had been used in the treatment of skin diseases and syphilis for many years. In 1907 and 1908 Col. F. J. Lambkin amongst others reported on the use of injections of atoxyl (sodium anilarsinate) in the treatment of syphilis—"as a result of the apparent beneficial effects from the use of atoxyl in sleeping sickness, it was suggested by Uhlenhuth that this drug might also prove successful in syphilis . . . being a . . . protozoal disease." He also reported a series of cases treated by means of intramuscular injections of soamin (sodium-aminophenyl arsonate), stating—"in these salts (arylarsonates) we are now in possession of a specific for syphilis, and the importance of this cannot well be exaggerated." Other similar arsenicals also were tried. In 1910 Col. Lambkin stated that he found that some cases which did not respond to either mercury or arsenic alone, readily responded to treatment by both metals, and expressed the opinion that a method of treatment combining both these metals would eventually be found to be the best. However, in March 1910, an expert committee at the War Office came to the conclusion "that the utility of these preparations (arylarsonates) . . . has not been proved and did not recommend their administration" (French, 1911).

In 1909 Ehrlich and Hata described salvarsan ("606"), and this was put on the market in December 1910. However, Colonel (then Major) L. W. Harrison, R.A.M.C., obtained a supply of this in July, 1910 (Gibbard and Harrison, 1910). Investigations into the treatment of syphilis by means of salvarsan were carried out at the Military Hospital, Rochester Row, London, during 1910 and 1911, and latterly were extended to several other centres. The "Report on the Health of the Army for the Year 1911," referring to this form of treatment says—"the results have been so eminently satisfactory in every way, that arrangements have been made for a greatly extended use of the drug in the Army."

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At first it had been hoped that one, or at the most several, injections of "606" would have been effective in promoting a permanent cure (the "therapia sterilisans magna" of Ehrlich), but this was not to be, and as experience grew the number of injections given was increased (Keogh, Melville, Leishman, Pollock, Harrison, 1913). Earlier treatment by means of "606," or "Hata," as it was sometimes then called, was by intramuscular or subcutaneous injection, as Ehrlich originally considered that it should be "fixed in the muscle or subcutaneous tissue" (C. Birt, 1910). A 40 c.c. solution of 0·6 gramme was injected in two injections of 20 c.c. into either buttock, or subcutaneously between the scapulæ or in the pectoral regions. As can be imagined this method of administration caused a varying intensity of pain, often lasting for about two days. Later, injections of 0·6 gramme of "606" in a solution of 200 c.c., however, were given by the intravenous route, in view of the formation of sloughs following subcutaneous injections (Gibbard, Harrison and Cane, 1911). Following the occurrence of a certain number of relapses among patients treated by means of "606" alone, it was decided to give, in addition, the older and more conventional mecurial treatment (Gibbard, Harrison and Cane, 1912), and experience fully justified the adoption of this combined treatment.

Treatment was also carried out at the Military Hospital, Rochester Row, with supplies of neosalvarsan or "914," which had been supplied by Ehrlich, the technique being much the same as that used in the case of "606." It was found that although less stable, "914" was much quicker to prepare, forming as it does a neutral solution in water, and was stated to have caused fewer reactions (Gibbard, Harrison and Cane, 1912). Later it was found to be possible to give concentrated injections of neoarsphenamine in only a few cubic centimetres of distilled water, which considerably simplified the extremely complicated technique which had been necessary heretofore.

The credit for most, if not all, of the pioneer work in the introduction of salvarsan treatment in England lies with the Royal Army Medical Corps. Dr. R. W. Johnstone in his "Report on Venereal Diseases" (1913), presented to both Houses of Parliament by Command of His Majesty, states: "On account of the special facilities for close observation of patients, during the course of treatment and afterwards, which exist at the military hospitals in this country, and because I have been afforded an opportunity of examining the careful and complete records kept at the Military Hospital, Rochester Row, I attach particular importance to the figures which Colonel T. W. Gibbard, R.A.M.C., and Major L. W. Harrison, R.A.M.C., have published on the comparative records of patients treated with salvarsan and without. They reported that out of 162 patients treated from the outset with intravenous injections of salvarsan, either alone or in conjunction with injections of mercurial cream, and observed for periods ranging from six to twenty-one months, 11 relapsed (that is, showed further symptoms, and required further treatment). The average period during which the relapsed cases had remained free from active signs of syphilis was seven months. By contrast with this, out of 102 patients who were thoroughly treated with mercurial injections and observed for six to twelve months, 85

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relapsed, the average period during which the relapsed cases had remained free from symptoms being 4·2 months."

The annual return of the Military Hospital, Rochester Row, for 1909 showed that 11·9 per cent of cases of syphilis on mercurial treatment alone were readmitted twice, and 2 per cent on three or more occasions during the first year of disease, whereas no case treated with salvarsan had been readmitted more than once (Gibbard, Harrison and Cane, 1912)—which as can well be realized, considerably reduced the number of beds occupied. But it must be remembered that even in much later years there still existed opponents of salvarsan. However, as Colonel T. W. Gibbard and Major L. W. Harrison stated in a Paper read at the Annual Meeting of the British Medical Association on July 30, 1914, "To-day it is not a question of whether or not we should give salvarsan, but how much of it we should give so as to secure the best result." They also pointed out that the Wassermann test, though an enormous advance, did not tell whether the *Sp. pallidum* was dead or only asleep, and "often fails to tell us of an active process in the central nervous system. . . . With regard to the latter we can always examine the cerebro-spinal fluid but we think it will be a long time before we have educated our patients to submit to lumbar puncture as a routine part of their treatment."

With the outbreak of war, supplies of salvarsan and neosalvarsan, whose sole source was Germany, were cut off. However, the methods of manufacture were known, and a Commission was set up to investigate the situation, and British equivalents manufactured as a result, also a French substitute for "1914"—novarseno-benzol "Billon"—was available. But, in some hospitals, arsenical treatment had to be limited owing to lack of supplies (Ffrench, 1915). In 1914 the latest form of treatment at the Military Hospital, Rochester Row, London, consisted of one dose of 0·6 gramme of "606," followed by five injections of mercury (to give a safe interval between doses ,and to prevent the spirochæte making headway), then one more injection of 0·6 gramme of "606" and five more injections of mercury were given, followed by a final 0·6 gramme of "606." Later experiences showed that this course of treatment gave a relapse rate (clinical and serological) of 25 per cent within one year (Harrison, 1923)) It was therefore considered necessary to increase the total dosage of arsphenamine. However, it had been reported that the injections of full doses of "606," at less than fourteen days' interval had caused death with cerebral symptoms in a number of cases, in inverse proportion to the interval between doses. In order to avoid the occurrence of these catastrophes, the policy was adopted of giving 0·3 gramme doses of "606" at short intervals, e.g. eight in twenty-eight days, combined with eight injections of mercury. It was also decided to repeat this course of treatment after a month's interval in those cases with a positive Wassermann reaction, and in secondary cases. Also a new complication arose which had not been experienced in British military hospitals before the war, this was the occurrence in 1915 of a certain number of cases of erythema and of severe dermatitis (History of the Great War, Medical Services). In view of the long period of incubation in some of these cases, it became obvious that even the most careful watching would

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not be enough, and so periods of rest were introduced to allow intolerance to manifest itself in susceptible patients. For example, in November 1915 the course used in France was lengthened to forty-two days—four injections of 0·3 gramme of "606" being given in the first fourteen days, followed by a similar series of injections after a rest period of fourteen days. In May 1916 the following course of treatment was in use in England.

Day of treatment		*Salvarsan or its equivalent*		*Mercury*
1st	...	0·3 gramme	...	grain 1
4th	...	0·3 gramme	...	—
8th	...	0·3 gramme	...	grain 1
15th	...	—	...	grain 1
22nd	...	0·4 gramme	...	grain 1
29th	...	0·5 gramme	...	grain 1
36th	...	—	...	grain 1
43rd	...	0·5 gramme	...	grain 1
50th	...	0·5 gramme	...	grain 1
	Totals	2·8 grammes	...	grains 8

52nd Blood test.
If the blood test is negative, treatment to be suspended and blood tests repeated at intervals of three months if practicable. If subsequently found to be positive, the above course to be given and a follow-up course as below. If the blood test on the 52nd day gives a positive reaction, continue as below.

54th to 68th Potassium iodide.

		Salvarsan		*Mercury*
69th	...	0·3 gramme	...	grain 1
76th	...	0·4 gramme	...	grain 1
83rd	...	0·5 gramme	...	grain 1

If still positive at the end of this time, advise chronic mercurial treatment. (History of the Great War, Medical Services.)

This course was again modified as below early in 1918, in order "to reduce the possibility of acute yellow atrophy, and to reduce the incidence of stomatitis due to mercurial injections."

Alternative Arsenical Preparations and Methods of Administration

Day of treatment	*Intravenously "606"*	*or "914"*	*Intramuscularly or into deep subcutaneous tissue "914"*	*Mercury Intramuscularly or Mercurial cream*
1st	0·3 gramme	0·45 gramme	0·45 gramme	grain 1
8th	0·3 gramme	0·45 gramme	0·45 gramme	grain 1
15th	0·3 gramme	0·45 gramme	0·6 gramme	grain 1
22nd	—	—	—	grain 1
29th	0·4 gramme	0·6 gramme	0·6 gramme	grain 1
36th	0·4 gramme	0·6 gramme	0·6 gramme	grain 1
43rd	—	—	—	grain 1
50th	0·4 gramme	0·6 gramme	0·6 gramme	—
57th	0·5 gramme	0·75 gramme	0·6 gramme	grain 1
59th	Blood test. If positive or doubtful, continue as below.			
61st to 75th	Potassium iodide.			
82nd	0·3 gramme	0·45 gramme	0·6 gramme	—
92nd	0·4 gramme	0·6 gramme	0·6 gramme	—

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If blood is negative on the 59th day, suspend treatment, and, if practicable, repeat blood tests at intervals of three months, but do not hold back from draft overseas.

In tertiary cases, provided that all symptoms have then disappeared, return to duty on 58th day regardless of Wassermann.

The above lines of treatment do not apply to that of syphilis of the central nervous system, cases of which should be treated on individual lines. The principle in such cases is to commence cautiously, increasing the individual dose gradually to 0·3 gramme "606" or equivalent in "914" and prolonging the course until the patient has received 4 to 5 grammes. A very successful method is to give a weekly intravenous injection of "606" and a weekly intramuscular of "914"—0·3 gramme in each case."

According to the History of the Great War, Medical Services, the above course did prove to be followed by "a definite reduction in the amount of dermatitis and ordinary jaundice." Later in some hospitals, courses consisting of four intravenous injections of "606" followed by four deep subcutaneous or intramuscular injections of "914" were adopted. During the period covered by the 1914–18 War, many other preparations were also tried in military hospitals. These in the main consisted of various compounds of "606," such as "Galyl" and "Silbersalvarsan," but their use was attended with little or no advantage.

In summing up the results of the methods of treatment of syphilis used during the Great War, Colonel Harrison, while pointing out that it was only possible to estimate the incidence of clinical relapse, "since it was not possible in any but a small percentage of cases to bring the patients back for blood tests," found a clinical relapse rate of 1·1 per cent in cases treated by means of 2·4 grammes of "606" and 7–8 grammes of mercury by injections in a series of 35,083 case cards scrutinized. He compares this with a series of case sheets of patients treated with mercury alone, studied in 1913, and concludes that it it reasonable to suppose that "under a purely mercurial system of treatment, a scrutiny of cards during the war would have revealed at least 50 per cent of the cases of syphilis to be relapses" (History of Great War, Medical Services).

Until 1923–24, treatment continued on much the same lines, except that the necessity for repeated courses came to be more than ever realized. For example at the Military Hospital, Rochester Row, three courses, each of seven injections of arsenic (combined with mercury), were recommended as a minimum in advanced primary and secondary cases (Frost, 1923). During 1923–24 intramuscular injections of bismuth preparations were introduced to replace mercury. The importance of this advance cannot be exaggerated, for, when used with care, in bismuth we have a more effective drug, with none of the serious toxic effects of mercury such as debility, loss of weight, distressing diarrhœa, stomatitis and ulceration of the mouth, loosening of the teeth, foul breath and intense salivation. For example in Cologne in 1923 there were over one hundred cases of mercurial stomatitis under treatment at the same time (Clarke, 1933).

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In order to ensure efficient treatment with the minimum of toxic reactions and adequate post-treatment surveillance, a standard course for patients suffering from early syphilis was issued as a guide by the D.G.A.M.S., in a circular during June 1928. This course, the result of past experience, was advised in sero-negative primary cases, for the average man weighing 140 lb., and was as follows:

			Intramuscular		*Or*
	"606" or "914"		*Sulphostab or*	*Bismuth*	*Mercury*
Day of	*Intravenous*		*similar preparation*	*Metal*	
treatment	*Grammes*	*Grammes*	*Grammes*	*Grammes*	*Grains*
1st	0·3	0·45	0·45	0·25 - 0·3	1
8th	0·3	0·45	0·45	0·25 - 0·3	1
15th	0·3	0·45	0·45	0·25 - 0·3	1
22nd	—	—	—	—	—
29th	0·4	0·6	0·6	0·25 - 0·3	1
36th	0·4	0·6	0·6	0·25 - 0·3	1
43rd	—	—	—	—	—
50th	0·4	0·6	0·6	0·25 - 0·3	1
57th	0·4	0·6	0·6	0·25 - 0·3	1
64th	Blood to be taken for the Wassermann reaction.				
65th to 84th	Rest of four weeks from last injection.				
85th to 98th	Fourteen days' treatment with potassium iodide.				
99th to 155th	Repeat course as far as the 57th day.				

It was suggested that this course be repeated after an interval of eight weeks in seropositive primary and secondary cases. For tertiary and neurosyphilis cases, while realizing that each case should be treated on its merits, it was recommended, as a guide, that treatment should first consist of the course suggested for seronegative primary cases, this to be followed by similar courses of only five weeks' duration at intervals of twelve weeks, potassium iodide being given by mouth during part of this time, the treatment being continued for at least two years. In the treatment of syphilis of the central nervous system it was suggested that smaller doses of arsenical preparations should be used at first, and that more prolonged treatment should be given than is usually considered necessary for ordinary cases. The employment of tryparsamide, it was suggested, might be considered in suitable cases, e.g. early general paresis. The circular laid down that seronegative primary syphilis cases with normal blood Wassermann and cerebrospinal fluid at the end of treatment, should be examined monthly for the first year after completing treatment, with blood tests every three months, followed by two further blood tests at intervals of six months, and a final examination, including cerebrospinal fluid, at the end of this period of two years. In the event of clinical or serological relapse, a course of treatment was to be given as for secondary syphilis. In seropositive primary and secondary cases, if the blood Wassermann was negative, and the cerebrospinal fluid normal at the end of treatment, a two-year period of observation as above was commenced. If these tests were not negative at the end of treatment, or if negative they subsequently became positive, a series of short courses consisting of three weekly injections of 0·3 gramme of an arsenical preparation together with mercury or bismuth was commenced, after an interval of three months from the last injection. These short courses were to be

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continued at six-monthly intervals until the blood and cerebrospinal fluid became negative. Very much similar courses of treatment had been laid down by the D.M.S. in India, and these were amended to conform with the above-detailed schedule later in 1928.

Later, some Army venereologists, however, preferred courses of treatment similar to those described above, but modified by increasing the series of injections to ten, and still retaining the intervals in the course with a view to avoiding toxic effects, the number of injections given being increased in sero-negative primary cases to three phases each of ten injections, later cases receiving a minimum of four phases (Clarke, 1933).

During the period between the two world wars, intramuscular injections of sulpharsphenamine were more generally used than intravenous neoarsphenamine owing to greater ease of administration.

The official schedule described above remained routine for some years (Memorandum on Venereal Diseases, 1936), until in the latter part of 1939. "Special Notes on the Treatment of Early V.D.," prepared by Brigadier (then Lieut.-Colonel) T. E. Osmond, was issued, and it was modified. The modifications introduced consisted in the main of omitting the intervals at the fourth and seventh weeks of active treatment, and increasing the dosage of the second and third arsenical injections to 0·6 gramme, and increasing the total number of arsenical and bismuth injections to ten. Four such courses were recommended for seronegative primary syphilis, and three courses following permanent conversion of the blood reaction to negative, for seropositive primary and secondary cases. An interval of four weeks was laid down between the first two courses given, with a five weeks' interval between subsequent courses. It was also recommended that, in spite of the ease of injection of intramuscular sulpharsphenamine, where available neoarsphenamine by the intravenous route was to be preferred as being more active therapeutically, and also less liable to produce side-effects, a fact which had become increasingly realized.

Some time after the commencement of the 1939–45 War, in order to conserve man-power, and at the same time to ensure that adequate treatment was possible under war conditions, various forms of intensive arsenotherapy were tried at certain Army V.D. treatment centres, and in 1944 the "twenty-day" treatment by means of multiple injections of mapharside, then in use in the U.S. Army, was adopted for selected cases. This consisted of 1,200 mgm. of mapharside given in twenty daily injections together with bismuth. Also a trial was made in selected cases in the Middle East to assess the intensive five-day treatment with mapharside, but this was abandoned owing to the incidence of toxic effects, especially encephalopathy (Lees, 1946). Other theatres experienced similar difficulties. However, the continuance of intensive arsenical treatment, with its increased dangers, was soon to be rendered unnecessary with the introduction and availability of penicillin. Also in B.A.L. (British Anti-Lewisite), which had been developed for use against the organic arsenicals used in chemical warfare, there at long last appeared a more promising form of treatment for such complications as arsenical encephalopathy, and arsenical dermatitis.

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During 1943, the rising incidence of jaundice following arsenical treatment gave rise to grave concern, for example, at one clinic 46 per cent of all cases treated developed jaundice (Beattie and Marshall, 1944). It was suggested (MacCallum, 1943; Bigger, 1943) that this condition was syringe-borne. This was later confirmed by investigations carried out at military hospitals, it being found that the incidence of this complication was considerably reduced when a system was employed, consisting essentially of the washing and boiling of syringes, which was carried out by one orderly who only handled "dirty" syringes (Salaman, King, Williams and Nicol, 1944; Laird, 1946).

In 1943, Mahoney, Arnold and Harris, in the United States reported the results of treatment of syphilis by means of penicillin, and by 1944 this new and non-toxic intensive method became the treatment of choice in the Army. From the very commencement of the treatment of venereal diseases in the Army by means of penicillin, it was decided that routine courses for the treatment of all early cases would be laid down. Hospitals, or groups of hospitals, were instructed to carry out the same form of treatment, in order that the large number of patients similarly treated would make possible the assessment of the effect of such treatment. The original schedule adopted for the treatment of early syphilis consisted of 2,400,000 units of penicillin in 60 doses, each of 40,000 units given intramuscularly in aqueous solution three-hourly over a period of seven and a half days. Treatment was followed by serum tests at two, four, six, nine, twelve, eighteen, and twenty-four months, and examination of the cerebrospinal fluid at six and twenty-four months.

However, after a time, relapses of an infectious type began to appear. Early in 1945 the Central Syphilis Register had been formed at the War Office. This holds a dossier for each patient under treatment or surveillance for syphilis, and consists essentially of case-notes on a series of Army Forms I 1220 which are forwarded by each Special Treatment Centre on each occasion a patient is either admitted to hospital, or attends for out-patient treatment or surveillance. In 1946, a scrutiny of the records of those patients treated by means of 2·4 mega units of penicillin alone who had been followed for six months, showed that there was a failure rate of 8 per cent (U.S. Public Health figures showed 15 per cent at 11 months) as compared with 2 per cent in patients on the twenty-day treatment with mapharside (Marshall, 1946). It was therefore considered that 2·4 mega units of penicillin was inadequate.

In 1945, in view of the results of experimental work by Eagle in the United States, which showed that penicillin and arsenic had a synergistic action in the treatment of rabbit syphilis, it was decided to try out at certain military hospitals in the United Kingdom a schedule consisting of 2·4 mega units of penicillin combined with ten daily injections of 0·06 gramme of mapharside. At other hospitals a schedule consisting of 4 mega units of penicillin alone, in four-hourly injections of 40,000 units over a period of twelve and a half days was adopted. For hospitals overseas a scheme consisting of 2·4 mega units of penicillin followed by one course of neoarsphenamine and bismuth over a period of ten weeks was laid down (Willcox, 1946). Subsequent scrutiny of record cards in the Central Syphilis Register showed that in round figures, the

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calculated cumulative relapse rate at twelve months for seronegative primary cases was 14 per cent, and for seropositive primary cases 13 per cent, and for secondary cases 17·5 per cent, in patients treated by means of 2·4 mega units of penicillin alone, and that the relapse rate using mapharside in addition, and 4 mega units over twelve and a half days, appeared to be essentially much the same (Eames, 1947).

Following reports from the United States early in 1946, which showed that penicillin "K" was less effective than penicillin "G" in the treatment of rabbit syphilis, and that commercial penicillin had recently contained increasing amounts of penicillin "K," it was decided by the Sub-Committee on Venereal Diseases of the Army Medical and Personnel Research Panel to increase the amount of penicillin given to all patients to 4 mega units—50,000 units of penicillin three-hourly for ten days—combined with 1·35 grammes N.A.B. and 0·6 gramme bismuth in divided doses on the second, fifth and ninth days, followed by 0·6 gramme N.A.B. and 0·2 gramme bismuth weekly for eight weeks. This scheme is still the standard treatment in use in the Army. Subsequent investigations have shown that bismuth when given concurrently has no apparent inactivating effect on the penicillin in the blood serum (Eames and Archer, 1947), but it is, as yet, too early to assess the efficacy of this treatment schedule, owing to the small number of cases it has been possible to follow-up, due to postings, and release from the Service.

In view of the greater incidence of arsenical encephalopathy (Prebble, 1946), it was decided that in the treatment of Indian troops arsenic would be omitted, and later because of difficulties in continuation treatment, it was recommended that treatment should consist of 4·8 mega units of penicillin alone in three-hourly injections over a period of twelve days.

The standard Army treatment for failures (serological, mucous, cutaneous and mucocutaneous) towards the end of 1945 consisted of 4 mega units of penicillin over twelve and a half days in three-hourly injections combined with 0·06 gramme of mapharside daily for ten days, commencing on the second day of penicillin treatment. This was modified in June 1946, when it was recommended that two courses of treatment, each consisting of 2·4 mega units of penicillin combined with ten weeks' long term arsenic and bismuth therapy, should be given.

Gonorrhœa

The reports of the Sub-Committee of the Advisory Board for Army Medical Services convened in 1903 to consider the treatment of venereal diseases in the Army contain full accounts of the methods of treatment in vogue in civil and military practice in the principal European countries, together with the opinions of experts. Such methods are described as the injection of a strong solution of silver salts which "act by causing desquamation of the superficial layers of the epithelium and active inflammation of the deep layers," medicated soluble bougies of iodoform, various preparations for irrigation of the urethra in the acute stages, and mixtures containing substances such as sandalwood oil, copaiba and salol for use during "the stage of decline." In its final report the Committee recommended that:

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(i) Diagnosis should always be confirmed, and treatment controlled microscopically.

(ii) Treatment should be controlled by Thompson's Two Glass Urine test.

(iii) In anterior urethritis the patient should be put on light diet, and dealt with by one of the followng two methods:

(*a*) By the method suggested by Neisser, viz. "bringing the gonococcus into contact with a powerful antiseptic at regular intervals during the day." For this purpose it is pointed out that silver nitrate solutions are too painful, and it is recommended that urethral injections of such compounds as albargin, argyrol, ichthargan, etc., be carried out at eight-hourly intervals, increasing daily the period during which the fluid is retained in the urethra from two minutes on the first day to finally fifteen minutes;

(*b*) By irrigation of the anterior urethra with potassium permanganate solutions 1 : 4,000, by means of either a douche can or 6 oz. syringe.

(iv) Chronic anterior urethritis should be treated by dilatation of the urethra by means of the passage of sounds, or an expanding dilator, or, if necessary, slitting open or cauterization of follicles by means of the urethroscope.

(v) For acute posterior urethritis, potassium permanganate irrigations of the bladder should be given, together with urinary antiseptics by mouth. For chronic posterior urethritis bladder irrigations with silver salts, sounds and prostatic massage are advised.

(vi) After the urine has been found to be clear on three successive days, the patient should commence his test of cure. He should be put on full diet and told to take "sharp exercise" for three days, and malt liquor may be given. If, after this, the morning urine is clear, the patient "can safely be considered cured." But, the report goes on to state, in cases with posterior urethral involvement threads will appear in the urine day after day. If this be the case, threads are to be stained and examined microscopically, and if no gonococci are found after three successive mornings, in spite of the application of 1 per cent silver nitrate to the urethra, the patient can be considered cured with reasonable certainty.

At the Royal Herbert Hospital, Woolwich, during 1907–8 gonorrhœa patients were treated by means of rest in bed, light diet, and fluids, alkalies and purgations during the acute stage (French, 1908). On about the sixth day, anterior irrigations of potassium permanganate were commenced. Posterior irrigations were used in posterior urethritis, but usually not before the fourth week. It was considered that all patients should be treated in hospital for six weeks at least, "whether the man says the discharge has stopped or not, unless threads are not present in the urine and microscopic examination of the centrifuged urine shows an absence of the gonococci, which is in the highest degree unlikely within the above-mentioned period." After a patient's discharge had ceased, and urine was quite clear, he was given beer for three days, and if his urine remained clear and no gonococci were found in smears he was "dismissed from hospital when ten to fourteen days free from suppuration." Following discharge from hospital the man was put under weekly surveillance for a period of one month. It was considered that by this system of treatment, relapses, and the then common complications of gonorrhœa such as chronic gleet, stricture, bubo, epididymo-orchitis and rheumatism were much decreased.

During the period immediately prior to the 1914–18 War, the use of vaccines was developed, and treatment tended to lavage of the urethra by means of large quantities of weak solutions of permanganate of potash or physiological salt solution, rather than the application of stronger bactericides. It was also

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established that clinical evidence alone could not be relied upon as a criterion of cure (Harrison and Harold, 1912), and that even the microscopic examination of the prostatic secretion in patients harbouring gonococci may fail to reveal their presence unless repeatedly carried out.

During the 1914–18 War, the treatment of acute gonorrhœa continued on much the same lines, and without dramatic improvements. The routine method was twice daily urethral irrigation with potassium permanganate solution: 1 in 8,000 to 1:4,000, and chronic cases were treated by dilatation, prostatic massage, etc. Intravenous injections of about 180 million T.A.B. vaccine, electrargol 2–10 c.c., or 10 per cent peptone solution, or the intramuscular injection of 10 c.c. of sterile milk, or of intramine were also found to be of value in the treatment of the complications of gonorrhœa. As it had been noticed that the symptoms referable to the gonococcal infection in patients suffering from both syphilis and gonorrhœa had undergone improvement following treatment by both mercury and arsenobenzol, trials of this means of treatment of gonorrhœa were carried out, however, improvement did not result. Also in 1917 McDonagh introduced the treatment of both acute and chronic gonorrhœa by means of courses of intramuscular injections of collosol manganese, alone or combined with intramine, and this form of therapy was used in a number of military hospitals (History of the Great War, Medical Services).

Routine local treatment was in many cases supplemented by means of various other therapeutic measures, of which only the most important will be described. Vaccines were extensively employed, including stock vaccines, autogenous vaccines, mixed vaccines and detoxicated vaccines. In this connexion the following four parallel series of cases investigated by Captain D. Lees quoted in the History of the Great War, Medical Services; Diseases of the War. Vol. II, 1923, is of interest:

	Duration in hospital
(1) Cases untreated with vaccine	58 days
(2) Cases treated with small doses of ordinary vaccine	45 days
(3) Cases treated with larger doses of ordinary vaccine	42 days
(4) Cases treated with very large doses of detoxicated vaccine	35 days

During the period of the Great War, it was found by both observation and controlled experiment, that local treatment was an essential adjuvant to any of the then known forms of general treatment.

In the twenty years following the 1914–18 War, little or no real advance was made in the treatment of gonorrhœa until the sulphonamides came into use. The multiplicity of forms of treatment and research described in the contemporary literature show that the previous state of affairs still continued at this time. Speaking of the Scarborough Congress of the Royal Institute of Public Health in 1923, Major A. T. Frost, R.A.M.C., summed up the position as follows: "In our treatment of gonorrhœa we have had as little success as the rest of the medical profession. So far as drugs are concerned, no advance has been made in sixty years since the introduction of potassium permanganate, and the reason is because we have not yet got the correct line of attack on the disease." It is interesting to find that Major Frost was of the opinion that

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attack must be through the blood stream, and in view of recent work on dyes he felt that eventually "one of the dyes formed with the benzine ring as a nucleus" might be found to have a selective action on the gonococcus.

Considerable work was carried out at the Royal Herbert Hospital, Woolwich, in investigating an exotoxic vaccine made from gonococci grown on nucleinic acid media, the vaccine was injected intradermally, and deep subcutaneously, and in some cases instilled into the urethra. Also, the use of intra-urethral instillation of an endotoxin vaccine for test of cure was investigated (Lambkin, Dimond and Robertson, 1927; White and Winter, 1929; Report of the Health of the Army for the years 1925, 1926, 1927, 1928). During this period these vaccines raised great hopes which were unfortunately not fulfilled. Later in consequence a series of different types of mixed polyvalent vaccines was tried (Crawford Jones, 1937).

Trials were also made with various solutions used for urethral lavage, e.g. 1 per cent saline (Clarke, 1929 and 1934), and 1 per cent saline with 5 per cent magnesium sulphate and methylene-blue (Report of the Health of the Army, 1934). By this time, most Army venereologists had come to the conclusion that lavage of the anterior urethra alone was not advisable, and prescribed lavage of the whole urethra in all cases, even in the acute stages, unless lavage was considered to be contra-indicated. Also, of recent years, it had become increasingly realized that the urethral mucosa was a delicate structure, and should be treated with respect. Hence the urethral lavage solutions used were more dilute (cf. Neisser's method above), the rationale being to merely wash away accumulated discharge and organisms. Also, instrumentation was carried out more carefully, and prostatic massage controlled by bacteriological examinations of the prostatic fluid. In consequence, the incidence of complications and sequelæ such as urethral stricture decreased.

Various intramuscular and intravenous injections were tried at different centres from time to time, e.g. intravenous injections of acriflavine (Murray, 1930), intramuscular injections of collosol manganese, manganese butyrate, S.U.M. 36, protein shock in the form of intravenous T.A.B. vaccine, and Aolan injections for chronic cases. Also such expedients as the local kataphoresis of colloidal antiseptics, and diathermy were tried (Frost, 1925; Report of the Health of the Army for the Year 1924), but these were later discarded.

At this time, observation following the completion of treatment in hospital consisted usually of weekly inspection of the urethra and urine, and prostatic massage for a period of about two months. In 1936 a surveillance period of three months was recommended (Memoranda on Venereal Diseases, 1936). The patient being retained in hospital until he satisfied the following criteria of clinical cure: (*a*) Absence of urethral discharge or other clinical evidence of disease; (*b*) absence of gonococci in either urethral or prostatic discharge after instrumentation or massage; (*c*) no active disease revealed by urethroscope examination, or examination over sounds and prostatic massage.

To-day it seems unbelievable that in comparatively recent times, gonorrhœa in the Army was a far more serious problem than that of syphilis. The unfortunate patient spent long weeks in hospital, receiving changes in the form

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of treatment from time to time, the disease often becoming chronic or complicated by bubo, stricture, epididymitis, arthritis, conjunctivitis, iritis, and "watering can" perineum due to sinus-formation following multiple periurethral abscesses.

It is interesting to note that in India during the year 1935, the average number of days in hospital was 47·22, and the relapse rate 23·2 per cent in the case of gonorrhœa patients (Report of the Health of the Army for the Year 1935).

The introduction of the sulphonamide group of drugs truly revolutionized the treatment of gonorrhœa, and from 1937 onwards their use was investigated at the various military hospitals treating venereal disease. At one hospital in 1937, patients suffering from gonorrhœa and urethritis were treated by means of sulphonamide P given in divided doses at six-hourly intervals between 6 a.m. and midnight, 6 grammes for the first four days, followed by 4·5 grammes for three days, and 3 grammes for the next two to four days. This regime reduced the average stay in hospital from sixty-two to twenty-one days (O'Hanlon, 1938). However, it was noticed that 19·5 per cent of patients failed to respond to treatment, and this was considered to be due possibly to the organisms being of a resistant strain. Relapse cases were treated by means of repeating the drug and where considered necessary urethral lavage. An alternative procedure recommended in India (Winter, 1939) consisted of 1 gramme of sulphanilamide six times a day for four days.

Tests of cure in the early days of sulphonamide treatment remained much the same. After the patient had been dry for four days following completion of treatment, he received provocation on succeeding days, including the drinking of beer and prostatic massage. If he remained clear of symptoms and signs he was discharged from hospital to attend for weekly inspection for a period of two months.

With the elaboration of M & B 693, a further type of treatment was introduced. In early 1939 it was claimed at one hospital that a 95 per cent cure rate was obtained by means of a course of 3 grammes daily for five days, followed by 1·5 grammes for three to five days (Officer, 1939). Later a course of the "8.4.2" type (Bowie, Anderson, Dawson and MacKay, 1939) was used in some military hospitals. This consisted of 15-20 grammes of M & B 693 in seventy-two hours as follows: 4 grammes on admission, 2 grammes after four hours, then 1 gramme every four hours during the waking periods. This method, it was claimed, gave an average stay in hospital of only 5·3 days (Buist and Simon, 1940). Other methods tried included the exhibition of 10 grammes of sulphapyridine immediately on admission in one dose (Dickinson Priest, 1943).

In December 1939, the following scheme of treatment by means of M & B 693 was recommended by Brig. T. E. Osmond in a memorandum, "Special Notes on the Treatment of Early Cases of V.D.": On admission 2 grammes, and 0·5 gramme every four hours during the day and 2 grammes at bedtime on the first day. On the second day 1 gramme on rising, 0·5 gramme after breakfast, dinner, tea and supper, and 1 gramme at bedtime (total 4 grammes). And from the third to the seventh days 1 gramme after breakfast, 0·5 gramme after

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dinner and tea, and 1 gramme at bedtime (total 3 grammes). Irrigation was to be used at the discretion of the medical officer. If the urethritis persisted, 3 grammes daily for a further three days was recommended. The following procedure was advised as a test of cure:

"(a) Before discharge from hospital 'to attend for further tests,' the patient should have been free from urethral discharge, and the urine free from heavy threads for one week after suspension of treatment; examination of the prostate and seminal vesicles should have revealed no sign of abnormality, and the expressed fluid should show no gonococci nor any large number of pus cells. Palpation of the anterior urethra over a straight sound should have revealed no abnormality, and full dilatation of the anterior urethra with a mechanical dilator should have provoked no return of discharge. The patient should be discharged at this stage only if he can attend for repetition of the tests as under.

(b) Tests should be repeated once weekly for three consecutive weeks, including urethroscopy, passage of full-sized sound into the bladder and microscopical examination of the prostatic and vesicular secretions.

(c) Three months later tests as in (b) should be repeated. At this sitting the blood should be tested for syphilis and if possible by the gonococcal complement-fixation reaction."

Later, supplies of sulphathiazole became available and was used in the treatment of gonorrhœa—at first the course used was the officially recommended 10 grammes in two days in divided doses, this being later increased to 25-30 grammes in four or five days (The Medical Use of Sulphonamides, 1943).

In view of the excellent results achieved by chemotherapy, and in order to conserve man-power, and reduce the number of occupied hospital beds, the policy of treating patients suffering from gonorrhœa in either unit lines, or forward medical units in the field was adopted. In fact, gonorrhœa had almost ceased to be a problem. However, the picture was soon to change. For some time there had been a feeling that results were not as good as they had been (Journal of the Royal Army Medical Corps, Editorial, June 1944). But as soon as the campaigns in Sicily and Italy commenced, it was found that less than 25 per cent of patients responded to treatment, and a large number of these relapsed on their way back to their units (Campbell, 1944). Increased dosage, repeated courses, change of preparation, adjuvant urethral lavage, intravenous injections of T.A.B., were all tried and found to be of little or no avail in resistant cases. The average stay in hospital, instead of a matter of hours or days, now became five weeks (Bell, 1945).

Towards the end of 1941, a special centre under the direction of Lieut.-Col. A. J. King, R.A.M.C., had been opened at the Royal Victoria Hospital, Netley, for the treatment of uncomplicated but resistant cases of gonococcal urethritis, patients suffering from gonorrhœal arthritis, and other complications which had proved resistant to treatment. This centre was equipped with facilities for hyperthermy treatment by means of the Kettering Hypertherm, and a number of sulphonamide-resistant cases were successfully treated by this means (King, Williams and Nicol, 1943).

Luckily, a certain amount of penicillin became available for the treatment of sulphonamide-resistant cases early in 1943, and in October 1944 supplies

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allowed of investigation into the optimal time-dosage, using 100,000 units, of this form of treatment at six centres in the U.K. In May 1945 penicillin by intramuscular injection became the official drug of choice for the treatment of acute gonorrhœa, and the policy of treating cases in unit lines was abolished. and all patients suffering from gonorrhœa were admitted for treatment to either a military hospital with a V.D. Department, or in certain cases specially selected Camp Reception Stations. Later the treatment schedule was increased, and patients were given five intramuscular injections of 30,000 units at two-hourly intervals, a total of 150,000, with tests of cure at three months, and a final blood test at six months to exclude syphilitic infection masked by the penicillin treatment (A.M.D. Bulletin, 1945).

As a result of experience, in 1946 it was laid down that the routine standard plan of treatment of gonorrhœa throughout the Army should consist of four intramuscular injections of 50,000 units at three-hourly intervals—a total of 200,000 units in nine hours. This routine has proved most satisfactory, and is in use at the present time. The patient is only detained in hospital, and is discharged as soon as free from signs and symptoms—usually under twenty-four hours. He is examined weekly for three weeks to exclude recurrence, and concomitant syphilis, and again at three months, when the prostatic fluid following massage of the prostate is examined microscopically, and a blood test carried out to exclude syphilis. If the patient passes these tests, he is considered to have been cured, but is advised to have a further test three months later to exclude a masked syphilitic infection.

Satisfactory results have also been obtained in a number of cases treated by means of 250,000–300,000 units of penicillin in oil-wax suspension given in a single intramuscular injection. The same criteria of cure being used as for treatment by means of aqueous penicillin. This is likely to prove a most useful form of treatment for patients stationed near to a Special Treatment Centre.

Other Diseases of Venereal Origin

It is only proposed to touch on the more common diseases of venereal origin.

Soft Chancre (*Chancroid*).—The diagnosis soft chancre was officially introduced into the Army in 1897 (Army Medical Department Report for the Year 1897, p. ix) the term "ulcer of penis" being "reserved for cases of non-venereal origin." As will be realized from what has been said of the diagnosis and treatment of syphilis, until the advent of dark-ground illumination, the differential diagnosis between syphilis and soft chancre rested on the presence or absence of induration, and an observation period of four months (Wilson, 1910). although the bacillus generally considered to be the cause of chancroid, and which bears his name, was described by Ducrey in 1889. When the Wassermann reaction came into general use, the observation of all sores of possible venereal origin included periodical examination of the blood serum, in addition to clinical examination. And the routine at the present time is, for all penile sores to be at first dressed with saline, until a series of dark-ground examinations has been carried out to exclude *Spirochæta pallidum*, only thereafter are antiseptics applied. After the sore has healed, the patient is discharged from hospital to attend for blood tests monthly for three months, before a final diag-

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nosis of chancroid is made. In its final report the Committee on the Treatment of V.D. and Scabies of the Advisory Board for Army Medical Services (1905) states that the normal treatment for soft chancre is "to apply lotio hydrargyri nigra to the sore early and to await events.". The report, however, draws attention to alternative methods of treatment, such as the local application of heat in order to destroy the *B. ducrey*, the application of iodoform, and the application of pure nitric acid after the use of an analgesic, pointing out that this latter method is apt to cause pain, and is "naturally not so popular as some of the others recommended." Treatment in the earlier years of the century also consisted of the application of various antiseptics such as perchloride of mercury, or touching with pure carbolic acid (French, 1908).

The treatment of chancroid during the period of the 1914–18 War consisted of the application of either sulphur or hypertonic salines, or after negative examinations for *Sp. pallida*, dressings soaked in a chlorine antiseptic solution. It was generally considered that caustics, and the cautery and iodoform were often harmful, and that the use of ointments interfered with drainage resulting in bubo. Buboes if present were aspirated and injected with various solutions, such as a 1:20 solution of tincture of iodine in water. Incision was only used if aspiration failed.

Much the same forms of treatment continued to be used for many years following the cessation of hostilities. Local measures included the application of various antiseptics, urotropine compresses, and cauterization with camphenol (Crawford-Jones, 1937). Buboes were treated in much the same way as heretofore. In addition to local measures, many forms of injections such as antimony compounds, intramuscular whole blood, intravenous Dmelcos vaccine (*B. ducrey*), and intravenous T.A.B., were all tried with varying success, but without appreciable reduction in the days spent in hospital or the incidence of crippling buboes. In fact no important advance in treatment was made over a period of many years. However, with the advent of the sulphonamides, the picture changed, and in these has been found a form of treatment which has reduced the stay in hospital, and prevented the formation of buboes. For example, it was reported that in the Citadel Military Hospital, Cairo, the number of days in hospital was reduced from twenty-eight to fifteen, and that no case of bubo occurred in a series of cases treated by means of sulphonamide (Clarke and Beamish, 1939). At first sulphanilamide was used in the treatment of chancroid, the dosage being very similar to that used in the treatment of gonorrhœa. Later sulphathiazole was taken into use. Treatment by the sulphonamides is still the most satisfactory form of therapy for chancroid.

Non-specific Urethritis.—Little can be said of the disease or diseases usually described by this name. Much the same unsatisfactory and multifarious forms of treatment were carried out in the past as in the case of gonorrhœa. At present, such cases are normally treated by means of 5 grammes of sulphathiazole for a period of five days, with or without urethral lavage. In mild cases treatment is carried out as an out-patient. Most cases appear to respond, and resistant cases are treated by means of further sulphonamides, urethral lavage, and hyperpyrexial therapy in the form of intravenous T.A.B. vaccine.

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Some light has been shed on one aspect of this condition—its possible connexion with abacterial pyuria—by work done at certain military hospitals (Vassallo, 1946; Fieldsend, 1946: Baines, 1947). However, there is no doubt that much remains to be learned about the ætiology of this condition, and investigations continue.

And that completes the account of the main tendencies of venereology in the British Army during the last fifty years. Stress has been laid on the more distant past, possibly to the exclusion of the immediate past and of the present —this was inevitable, but the present is available for all to see. What the future will hold, who can guess? What is the future of penicillin? One might even ask, what is its present position in the treatment of venereal diseases? Is the treatment of syphilis by penicillin alone justified, or should it be combined with both arsenic and bismuth? Some feel that the future lies in a combination of penicillin in the form of crystalline "G" salt with a course of bismuth, and possible repeated courses of penicillin. Does the future hold resistant strains, not only of the gonococcus, but of the *Spirochæta pallidum*? Is penicillin but the forerunner of future more powerful antibiotics? Who knows? One can only agree with Hamlet when he says: "There are more things in heaven and earth, Horatio, than are dreamt of in your philosophy."

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ANÆSTHESIA

BY

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THE art and practice of anæsthetics in the Army has made great strides during the period of existence of the Royal Army Medical Corps.

Most of the advances have been made during the two Great Wars, when the problems of anæsthesia for wounded men under active service conditions have produced new techniques and improvements in the established methods.

In the early days of the Corps existence, anæsthesia was not regarded as a subject of much importance; to quote Major-General J. W. West, then a junior surgeon, "Any Medical Officer was considered as suitably trained to give a general anæsthetic and, when the infrequent operation occurred in a Military Hospital, the surgeon had to search round for some officer otherwise disengaged, who would administer the anæsthetic." Although the surgery in military hospitals of those days was not very enterprising, it was not the operation but the anæsthetic which caused anxiety; chloroform was the only anæsthetic available, and deaths under anæsthesia did occur. The inexperienced anæsthetists were a sore trial to the surgeon; the wait during induction was often long, the struggling of the patient great, and complete relaxation of the abdomen rare. Salivation, in spite of atropine was troublesome, and post-operative vomiting almost universal. A few medical officers, mostly trained in Scotland, gave chloroform with a folded towel and a drop bottle most satisfactorily, but anxiety never ceased until the patient was safely back in bed.

During the South African War conditions such as those described above obtained; there were no specialist anæsthetists and little equipment. Chloroform was the agent used and it was often difficult to find a medical officer willing to act as an anæsthetist. It is interesting to note that in 1904 an investigation was carried out to ascertain whether deterioration occurred in chloroform exposed to hot climates on active service. Samples of chloroform from South Africa and from the China Field Force were, at the request of Army authorities, examined by Dr. F. W. Tunnicliffe, Professor of Pharmacology in King's College, London. After an exhaustive series of tests, it was found that these samples of chloroform showed no change in properties.

In the years between the South African War and the First World War, various new methods of anæsthesia were tried in the Army. Local anæsthesia using B-eucaine and adrenalin for minor operations was employed by Captain J. W. Houghton in 1905. Spinal analgesia was first used in military practice in 1907 by Major C. G. Spencer and Captain J. W. Houghton at the Q.A. Military Hospital, Millbank. Stovaine was the agent used, according to

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Barker's original technique, and excellent operative conditions were obtained, though the incidence of post-operative headache appears to have been relatively high. Captain Houghton published a series of articles in the Journal on spinal analgesia; in 1909 he used tropocaine in Sierra Leone and published further series of cases using stovaine in 1911, 1912 and 1913.

The absence of trained anæsthetists and the difficulty of finding officers to administer general anæsthetics made the practice of the spinal method highly acceptable to Army surgeons, and made it possible for them to operate in out-of-the-way stations and on board ship without other trained assistants.

During this period up to 1914, ether came into use in military hospitals in the United Kingdom and the Clover's inhaler was the apparatus employed. Mixtures of chloroform and ether were used, and ethyl chloride was sometimes used for induction.

Though the Senior Course at the R.A.M.College produced medical officers specially qualified as surgeons, no attempt was made to have officers specially trained in anæsthetics and it was suggested in articles in the Journal in 1904 and 1905 that N.C.O.s of the corps should be trained in the administration of anæsthetics, though there is no indication that this suggestion was ever implemented.

In India, during the period up to the First World War, chloroform was given by the open method and was the general anæsthetic mainly used, the official view being that ether would not be effective in the hot weather, and the difficulties of transport and storage of ether was considered to make its use impracticable. An individual surgeon procured privately a Vernon Harcourt chloroform inhaler and used it with great improvement in the induction and maintenance of anæsthesia and in the post-operative condition of the patients. No trained anæsthetists were available in military hospitals, and anæsthetic duties had often to be delegated to members of the Indian Medical Department. Eventually, official objections to ether were overcome, and it was supplied to military hospitals, but as no special apparatus for its administration was available, the open method had to be employed. Individual surgeons also used spinal analgesia with stovaine and local anæsthesia with B-eucaine, providing their own apparatus as there was no official supply of such equipment.

During the 1914–18 War, much was learnt about anæsthesia for wounded men under active service conditions and notable advances were made.

In a short survey of this nature, it is not possible to deal with all the details of the techniques evolved; the subject has been very adequately dealt with by Captain H. P. Crampton in the "Medical History of the War." For the first two months of the 1914–18 War, chloroform was the only anæsthetic available for medical units in the field, but after this ether and other agents were procurable.

In the early part of this war, before the establishment of Casualty Clearing Stations, a certain amount of surgery had to be undertaken in Field Ambulances, and chloroform supplied in sealed glass tubes was useful on account of its portability.

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To quote Dr. Ashley Daly: "It was soon learned (1) that prolonged deep ether or chloroform anæsthesia had a bad effect on a shocked or septic patient: (2) that spinal analgesia was dangerous and must be avoided in these cases: (3) the danger of operating on a shocked patient without resuscitation treatment; (4) the value of blood pressure readings in estimating the degree of shock present."

A notable advance was the introduction in 1916, of Dr. (later Sir Francis) Shipway's well-known warm ether apparatus, by means of which warmed ether and/or chloroform vapour could be delivered to the patient using oxygen or air to vaporize these agents. This compact and convenient apparatus was extensively used in Casualty Clearing Stations and hospitals throughout the war.

The patients, then, as now, were nearly all heavy cigarette smokers and ether by the open method tended to produce a high incidence of post-operative pulmonary complications, which was considerably reduced after the introduction of the "warmed ether vapour" method. Ether was also administered by means of the Clover's inhaler and to a limited extent by the rectal and intravenous routes.

In 1916, nitrous oxide and oxygen became available and were administered by the Boyle's apparatus. It was soon found that, in skilled hands, this was the method of choice for use on the severely wounded and shocked patients or toxic patients with gas gangrene: small quantities of ether could be added if required, especially during induction, and it was of great importance to ensure that there was no limitation of the oxygen supply. After adequate pre-operative resuscitation, transfusion, warmth, etc., these patients came through prolonged and serious operations and post-operative effects were markedly reduced. Owing to difficulties in the supply of gas and the scarcity of skilled administrators, this method had often to be reserved for selected cases.

Spinal analgesia with stovaine was found to be followed by a dangerous fall in blood pressure, and its use in forward medical units was soon abandoned entirely. Stovaine and novocain were used in Base hospitals for spinal analgesia for amputation through the lower extremity, though spinal methods were not on the whole favoured by surgeons.

Local anæsthesia by infiltration with novocain was used by some operators either alone, or combined with light general anæsthesia with nitrous oxide and oxygen. Successful use of local methods was made in a Special Head Unit at the Base under the direction of the late Colonel Sir Percy Sarjent. Towards the end of the war the endotracheal administration of anæsthetic vapours by the insufflation method was introduced and proved invaluable in dealing with facio-maxillary cases.

As regards personnel, up to 1916 there were no specially trained anæsthetists, anæsthetics were administered by any medical officer available in a medical unit. Then special anæsthetists were appointed on the staffs of Casualty Clearing Stations as members of surgical teams; none of these officers

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so appointed were regular officers of the Corps. In 1918 some two hundred nursing sisters, having been specially trained as anæsthetists, became available for service in Casualty Clearing Stations and many of them became very skilful; they also freed a corresponding number of medical officers for duty at the front where there was a serious shortage of the latter. To quote from the "Medical History of the War," "The art of administering anæsthetics was greatly developed during the war with immense benefit to the patient and the surgeon. The increased supply of special apparatus contributed very greatly to this result and the administration of warm ether vapour and of gas and oxygen instead of chloroform saved many lives."

In the years between the World Wars, anæsthesia in the Army progressed more or less *pari passu* with anæsthesia in civil practice, though there was often a time lag between the introduction of new agents and their issue as an official supply and, in some cases, anæsthetists purchased their own drugs and equipment in order to keep up to date.

In India, however, things remained as they had been before the 1914–18 War: chloroform, ether by open method, and nitrous oxide and air were considered by the Government of India to be modern and adequate methods of anæsthesia. It was not till the 1930s that modern anæsthetic apparatus became an official supply, and even in 1934 a Vernon Harcourt chloroform inhaler was produced with great pride by an Indian store-keeper as "modern equipment."

Endotracheal anæsthesia by the insufflation method was in use in large military hospitals in the U.K. and an article on this method was published in the Corps Journal in 1929 by Major L. M. Routh. Later the methods of blind intubation and inhalation endotracheal anæsthesia came into general use by anæsthetic specialists.

Avertin is first recorded as having been used in the Army in 1934 by Major L. S. C. Roche, and in the same year intravenous barbiturates came into use in military anæsthetic practice, a series of fifty cases using evipan being published in the Corps Journal by Major K. P. McKenzie.

It was, however, in the training and status of anæsthetists that great strides were made in the years between the two world wars.

The Senior Courses for officers at the R.A.M.College, Millbank, were resumed after the war and anæsthetics was recognized as a special subject; in 1920, after special training in civil hospitals, Captain R. Martyn Davies became the first Regular specialist in anæsthetics in the Corps.

The speciality was not a popular one, as the number of hospitals requiring a full-time anæsthetist at the time were few, and anæsthetists were only entitled to specialist pay when employed as such, and if posted to one of the smaller military hospitals, they remained General Duty officers. Still, a number of specialist officers were trained and, after the inception of the Diploma in Anæsthetics in 1935, a few Army specialists were successful in obtaining this Diploma.

The outbreak of the second World War in 1939 saw an enormous expansion in the personnel of the Corps. Almost all the Regular anæsthetists were

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soon employed on non-professional duties and a large number of skilled specialist anæsthetists came into the Army from civil life.

In 1941 Major Ashley Daly was appointed the first Adviser in Anæsthetics to the War Office with the rank of Lieutenant-Colonel, and in 1945 he was made Consultant Anæsthetist with the rank of Brigadier; the first anæsthetist ever to attain this rank in a purely professional capacity. Under his wise guidance the anæsthetic service of the Army grew "in wisdom and stature." Advisers in the rank of Lieutenant-Colonel were appointed to overseas theatres of war, M.E.F., C.M.F., B.L.A., etc., these officers being chosen from anæsthetists who were on the teaching staff of civil hospitals in peacetime.

In 1944 Brigadier H. K. Ashworth was appointed as Consultant Anæsthetist to G.H.Q., India, and Advisers were appointed in each of the four commands in India and one with H.Q., A.L.F.S.E.A.

The appointment of these Advisers in Anæsthetics was of great importance in raising and maintaining the standard of anæsthesia in the Army. The Adviser was usually in a position to tour forward medical units and Base hospitals in his area, when he could make personal contact with anæsthetists and help them with their professional, and sometimes personal problems, and stimulate their interest in new techniques. An important part of the Adviser's duties was the supervision of the teaching of trainees, which was carried out in all overseas theatres. The morale of anæsthetists was greatly assisted because they felt they had someone "higher-up" looking after their interests and ready to help them with their personal problems.

At the Headquarters of the formation the Adviser had a close liaison with the Consultant surgeon and was able to help with the posting and distribution of anæsthetists according to their ability.

As regards the supply of anæsthetics, agents and equipment, the specialized knowledge of the Adviser enabled him to be a great assistance to administrative medical authorities.

In the matter of the technical development of anæsthetics during the war, space does not allow of a detailed description of the intricacies of the various methods used. One cannot do better than quote from the memorandum on anæsthesia written by Brigadier Ashley Daly in the "Field Surgery Pocket Book" (1944): "Since the last war (i.e. 1914–18) the problem of anæsthesia in the Field has been simplified by the introduction of new drugs and improved methods of administration of the older agents. Chief among these innovations are the development of the intravenous route, consequent upon the discovery of the various barbiturates, the use of agents such as cyclopropane and trilene, and the invention of a most useful machine for giving definite percentages of ether and air known as the Oxford Vapouriser Number One. Considerable advances have also been made in the technique of local anæsthesia and though its use in war surgery is chiefly to reinforce general anæsthesia, local blocks, e.g. brachial block, are useful in severe injuries of the hand, and intercostal block combined with bilateral splanchnic block is occasionally used for an abdominal injury. Spinal analgesia has a very small place in the surgery of the wounded man."

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The importance of adequate resuscitation before surgery was undertaken on the wounded man was fully realized; the magnificent work of the blood transfusion units, which worked in close touch with the surgical teams, lightened the anxieties of the Field anæsthetists to a considerable extent.

The adequate premedication of patients before anæsthesia was a matter of importance and was usually carried out by the transfusion officer in liaison with the anæsthetist, care being taken not to administer morphia to a patient who had already received a heavy dose of this drug as part of first aid. Omnopon and scopolamine were usually employed and when necessary were given intravenously.

Of all the anæsthetic techniques employed during the war, perhaps the most outstanding success was the use of pentothal sodium. It was used as the only anæsthetic for a large number of wounded men and almost as a routine induction before proceeding to an inhalation agent. Extreme caution was required in cases suffering from "shock," e.g. cases with abdominal wounds or extensive injuries of the limbs and only very small amounts of pentothal were required for induction in the former and for induction and maintenance in the latter type of case.

In patients with extensive burns, such as were seen in the Western Desert campaigns, great caution was required when administering pentothal, and where possible intravenous omnopon and morphia only was given in these cases.

Oxygen was often given during pentothal anæsthesia, and nitrous oxide and oxygen were used to supplement the pentothal anæsthesia in many cases.

The more severely wounded always came to the theatre with a blood, saline, or plasma transfusion set up and induction of anæsthesia was easily carried out by injecting a small amount of pentothal solution through the rubber tubing of the transfusion apparatus. On many occasions when a patient recovered consciousness after an extensive operation he would enquire when the operation was to take place; what a contrast to the South African War!

Endotracheal methods were used in appropriate cases by all anæsthetists and were especially valuable in facio-maxillary and in neurosurgical units.

Cyclopropane was available for most chest and neurosurgical units, and in the later stages of the war was supplied to other surgical units also.

The supply of gases used in anæsthesia, nitrous oxide and oxygen, presented considerable difficulties in overseas theatres of war, when shipping space was limited and cylinders had to be returned to the U.K. for refilling. This difficulty was overcome to a large extent in the Italian theatre by obtaining large cylinders of nitrous oxide containing 3,000 gallons from which the small cylinders used professionally could be refilled. Oxygen cylinders were refilled by the R.A.O.C. with gas manufactured in Italy, and a natural source of carbon dioxide was found at Pompeii, from which cylinders for medical purposes were refilled. This service was organized by Lieut.-Colonel B. R. M. Johnson, Adviser in Anæsthetics, C.M.F., with the help of the R.A.O.C. and the R.E.M.E.

As regards anæsthetic equipment, the field pattern Boyle's apparatus did

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good service in all theatres of war and was even packed in special containers for mule transport in the Burma campaign, but it was not sufficiently accurate for modern methods of anæsthesia. The addition of a to-and-fro carbon dioxide absorber increased its sphere of usefulness.

In 1944, a portable military model of the American Heidbrinck apparatus was introduced, which was a great advance on the Boyle's apparatus.

Mention must be made of the great ingenuity and resource shown by anæsthetists in all theatres of war in modifying existing machines to modern techniques and even in constructing new apparatus. The container of the Service respirator was utilized as a carbon dioxide absorber and many other ingenious modifications were carried out with the willing help of the craftsmen of R.E.M.E. Also various types of apparatus for the continuous administration of pentothal sodium were devised by anæsthetists on active service.

So far post-war anæsthetic practice in the Army has maintained the high standard reached during the war and is equal to that reached in civil life. Military hospitals are equipped with modern apparatus, and up-to-date techniques, such as the use of curare, are employed by trained anæsthetists.

It has been said that the "corner stones of modern surgery are asepsis and anæsthesia." Many of the surgical procedures carried out during the war would have been impossible, had it not been for modern anæsthetic techniques, and the skill and devotion of the anæsthetists who, often in circumstances of considerable danger and discomfort, unobtrusively carried out their duties and worthily upheld the traditions of the Royal Army Medical Corps.

For most of the information contained in this survey, the author is greatly indebted to the following: Major-General J. W. West, *C.M.G., C.B.E.,* F.R.C.S.; Brigadier Ashley Daly, F.R.C.S.; Lieut.-Colonel R. Martyn Davies, M.D.; and Colonel G. D. Gripper.

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MILITARY OPHTHALMOLOGY 1898-1948

BY

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A SAVAGE adversary, infantry, squares, cavalry charges, flags, spears and Gatling guns; these all set the scene for a canvas by Lady Butler or yet another colossal epic in Glorious Technicolour. The date was 1898 and the place Omdurman—the last battle to fit into the pattern of Victorian colonial warfare.

So it is with slight amazement that we read that only two ophthalmic casualties resulted from out of all the sandy turmoil. The first man had sustained a retinal detachment, and in due course "continued his service with the colours"; whilst the second casualty whose "orbit was penetrated by three fragments of a Remington bullet" had, in the words of the report, "his globe enucleated with success."

What, you may ask, was the soldier of fifty years ago expected to be able to see? Only the whites of their eyes? And what role did ophthalmology play in the military Medical Services of the day?

To answer these questions we have to go back and examine the reports of the Army Medical Department for the year 1860.

In the 1860 report was faithfully copied the following pronunciamento from the powers-that-be. "The extent of the range of vision of the soldier is subject to the decision of military authority and should be to the limit of the effective use of his rifle."

The Enfield rifle had just been generally introduced with a maximum effective range of some nine hundred yards. So it was decided that the soldier must be able to see a three-foot bull's eye target at six hundred yards.

For testing recruits at the various centres, this target had to be scaled down. A comparable series of dots of size 0·12 inch were arranged in various patterns on a card which the soldier had to read when held fifteen feet away. This test was soon found to be too difficult, and the distances had to be modified to ten feet for a "soldier of the line" and five feet for the Militia and Departmental Corps. The Cabbalistic equations and erasures on Sir Thomas Longmore's portrait in the Millbank Mess ante-room may well be the artist's symbolism for the difficulties mathematical and otherwise he overcame in the introduction of the test.

There was another test in vogue ,copied from the Austrian Army, which involved the use of ten dioptre convex and concave spectacles to read Jaeger test type, but this was never the most fancied method. Incredible as it may seem, the "Dots Test" remained the official test until October 1906. Even as

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late as 1910 we find some conservative medical officers writing to the Journal to say that they preferred it to the newly introduced Snellen's chart.

The files of the period contain three links with a remoter past. In 1860 were laid down the official rules whereby and whereunder an outbreak of "Ophthalmia" was deemed to become an "epidemic" in a regiment.

A somewhat pathetic footnote mentions that "since the invention of the ophthalmoscope (1848) it is now possible to reject recruits with visual-defects with certainty." The Pension Warrant of 1864 permitted serving soldiers who had lost one eye in battle to be retained with the Colours.

Remember that in 1898 no man in the Army was permitted to wear spectacles; that there were no ophthalmic specialists, and that in the decade 1892-1902 for an average of 66,000 recruits examined by the dots some forty per thousand were rejected.

The South African War 1899-1902

The original garrison of South Africans at the start of the war was about ten thousand men. Some 370,000 reinforcements had to be sent out during the three years to maintain a field-force of 56,000 men.

The ophthalmic problems were few, some of the Field hospitals had ophthalmic departments but not many. Some 2,363 cases of acute conjunctivitis were treated and 859 men were invalided home for errors of refraction—reservists. The report of the Imperial Yeomanry Hospital mentions amongst their notes one of the first instances of close collaboration between the ophthalmologist and the surgeon over head wounds.

Some idea of the type of fighting can be gained from the fact that this patient had been shot through the occipital lobes whilst engaged in a rifle duel with a Boer from behind boulders some fifteen yards apart! Cases of eye-injury are mentioned as being mainly due to bullet wounds rather than to shell wounds. Retinal detachment as in the 1914–18 War was practically non-existent.

Late in the war permission to wear spectacles "on or off duty" was granted but the value of this permission was stultified by glasses being prohibited "on active service or on parade." Night-blindness was not a major cause of malingering, but the optical delusions of the cordite-eaters were duly recorded.

By 1905 the R.A.M.C. showed some seven ophthalmologists on its strength; three having qualified at the first course of the newly formed R.A.M.College. By 1909 these had increased to fifteen and by 1914 there were thirty. At this period the continental armies accepted a corrected vision of 6/12 for their infantry. So the argument raged for and against the use of spectacles in the British Army. Eventually the issue of spherical lenses was permitted by 1914, but again "Not on active service."

The equivalent reading on Snellen's chart to the dots-test was 6/24 either eye. This was to remain the entry standard until 1907. Recruits were then accepted with 6/36 vision in the one eye provided the other achieved 6/6 and they were allowed to fire off either shoulder.

In 1914 the first tests for flying personnel were mentioned. An hyperme-

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tropia of three dioptres was stated to be acceptable and candidates worc opaque spectacles to be spun in a revolving chair to test for ocular nystagmus.

The 1914–18 War

As was only to be expected military ophthalmology made enormous strides during this period.

The drain on the nation's man-power soon caused the entry standards to be lowered and settled the question of spectacles for the fighting soldier. By 1915 the General Service standard had fallen to 6/24 right eye uncorrected and 6/60 left eye uncorrected. With the establishment of the Army Spectacle Depot men were accepted for General Service with vision less than 6/60 but better than 2/60 provided they improved to 6/12. Men in the B.2 category need only have one eye and that only to improve to 6/60 with glasses.

The Army Spectacle Depot started in March 1916 by dispensing spherical lenses only but soon gave out cylindrical lenses. By the end of the war any type of spectacle was being made and the Depot had taken on the supply of artificial eyes as well. Some idea of the expansion that became necessary can be gained when it is realized that at its peak it supplied spectacles, lenses, etc., to a total of 131 ophthalmic centres including 98 in the United Kingdom and 5 in the United States of America.

The reports on the battle casualties are extremely interesting. Wounds of the eye comprised some 2½ per cent of all cases. 6 per cent of these were due to concussion effects of explosions, etc.

Whereas in the 1870–71 War some 55·6 per cent of all eye-wounds in the German Army had developed Sympathetic Ophthalmia, only one such case was reported from the British Armies in France throughout the whole war. This legend of Sympathetic Ophthalmia dies hard, but again in the 1939–45 War only one or at most two cases were the result of all ophthalmic casualties in all theatres of war. Similar evidence as to the scarcity of this lesion was given by Wurdeman in respect of the French battle casualties. His analysis of cases showed that 67 per cent of men wounded in the eye, lost that eye. Approximately 50 per cent of the intra-ocular foreign bodies were non-magnetic, and the removal of magnetic fragments was effected only through the anterior route which led to considerable terminal upset of the function of vision.

When the flood of gas casualties was analysed it was found that only in 10 per cent of the whole was the cornea affected. 15 per cent had lesions of the conjunctiva and the remaining 75 per cent suffered only from blepharospasm. Twenty years afterwards the old corneal and limbal lesions were to break down with the passage of time and cause considerable trouble for ophthalmologists all over the country.

Ophthalmic centres which at first were located only in Base areas were soon found to be necessary in the forward areas. After November 1914 advanced ophthalmic centres staffed by a specialist, nursing orderlies and opticians were attached to the Casualty Clearing Stations in the Army areas.

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The General Hospitals arranged special ophthalmic wards, and there were developed ophthalmic divisions in the Convalescent Depots.

At first there were only two Haab magnets in France, and the wounded with intra-ocular foreign bodies had special red labels tied to their field medical cards to be routed to the "Magnet Centres." Soon, however, a magnet-car was built to tour the ophthalmic centres and, later, a portable magnet was made and issued to each centre.

A special pathological centre was formed for the study of eye-conditions and the services of an enlisted ophthalmic fundus artist engaged.

No special hospital could be arranged to cope with the gas casualties, but in England one hospital (St. Dunstan's) was devoted to the treatment of bilateral eye injuries. St. Dunstan's had to treat and train in their new vocations some two thousand men from the Empire's war-blinded. Otherwise the ophthalmic casualties had to be spread throughout the various hospitals in the United Kingdom, and there were naturally many complaints as to the difficulties of segregation and obtaining specialist treatment.

Other points from the reports were of ophthalmic interest. During one year in France, 1915-16, there were only 23,809 cases for refraction: a mere shadow of what was to come.

This first truly National Army drew into itself all sections of the community and held a majority of the urban population. Many men who had been townsmen all their lives had no previous conception of absolute darkness and reported sick with "night-blindness." This disease-without-signs had been known as a cause of malingering as far back as the times of the Crusades. But horror of pitch-darkness combined with the old atavistic fear of things that "go wump in the night" led to shoals of men reporting sick; duly to be labelled "neurasthenia." Up to 1916 the main cause of ophthalmic malingering was said to be "blepharospasm."

The fear of an epidemic of "ophthalmia" as occurred in the days of the Napoleonic invasion of Egypt haunted the minds of the medical authorities in the Levant. It was not to be until the end of the 1914–18 War that the epidemiology of the acute conjunctivitis from the Koch-Weeks' bacillus and the gonococcus was to be clearly differentiated from the chronic conjunctivitis of trachoma. There used to be in the Moorfields Hospital Museum an extremely relevant newspaper cutting of 1806 wherein a Member of Parliament stated without equivocation that he considered that the Egyptian blight was not trachoma but a disease due to the intemperate habits of our enemies' soldiery.

The greatest tragedy was that of the Turkish prisoners of war in the camps in the Canel Zone. Most of them were suffering from the effects of malnutrition and the camps were swept by an epidemic of Koch-Weeks' and gonorrhœal conjunctivitis. Their own doctors tightly bandaged up the discharging eyes and literally hundreds of globes had to be removed because of panophthalmitis.

The medical authorities in France were equally apprehensive of the spread of "trachoma" from the 100,000 men in the Labour Corps, which was composed of Chinese, Egyptian and Cape coloured boys. The initial Chinese

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drafts provided a 13 per cent incidence: but directly the recruiting agencies were made to reject all with "granulations or acute conjunctivitis" the incidence fell level to that of the Cape Boys at 3 per cent. Roughly 8 per cent of the whole labour corps was affected with 8,500 cases of established trachoma.

For administrative purposes the men were split into three types of Companies each with their own individual laundry facilities. "X" Coys. of apparently "clean" men who received a daily drop in their eyes of boracic and zinc. "Y" Coys. of dubious cases who received daily argyrol or silvering of their lids and "Z" Coys. who were established cases of trachoma. The last two companies were under the direct supervision of an ophthalmologist. As a result no epidemics of acute conjunctivitis occurred and little work was lost from the Labour Corps.

The Americans touring the British medical "set-up" in 1917 noted that we were extremely keen on the efficient ophthalmic care of cases with head injuries. However, the Americans were the first to allocate a special hospital for the treatment of ophthalmic, facio-maxillary and head wounds. This precursor of the "Trinity" they disguised by name as the "Head Hospital."

For the first two years after the 1914–18 War the American, British and Canadian ophthalmic journals were full of valuable observations. Interest in military ophthalmology gradually died and all this knowledge had painfully to be regained at the start of the next conflict.

In 1920 the standards for entry to the Army were raised to 6/18 either eye uncorrected, with an alternative of 6/6 right eye and 6/36 left eye uncorrected for General Service. The numbers of recruits rejected were 6·4 per thousand in 1923 and 4·6 per thousand in 1925. Spectacles were permitted to give equivalent vision to the above but the arguments re glasses and shooting were duly resurrected.

Three ophthalmologists qualified at the first post-war College course, and ophthalmic departments were now to be found in all Commands at Home and most of those abroad. However, a partial ban on operating was introduced which later was to cause a lot of trouble when ophthalmologists first came up against a flood of battle casualties. Research continued and was appropriately mentioned in the yearly reports. In 1928 investigations were conducted into the problem of binocular vision and respirators; the illumination of test-type charts and the vision required of signallers. The effect of hypermetropia and astigmatism on musketry are spoken about in 1932. The Ishihara test became the official Army colour test in 1933, and all recruits with vision under 6/12 had to be tested at Millbank. Also in 1933 Indian troops with trachoma were made acceptable; a very different affair from the days of "Ophthalmia."

In 1934 the first successful treatment of retinal detachments with diathermy are recorded. An excellent selection of equipment was at this period designed and issued in due course to centres, and this was to prove up to all demands that the coming war might make upon it.

The Ministry of Pensions took over the Army Spectacle Depot and during this inter-war period were responsible for the supply of spectacles to the Army.

In 1938 lack of recruits caused the standards of entry once again to be

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lowered, and then were elaborated the forerunners of the famous Seven Visual Standards and Categories that served ophthalmologists so well in the second World War.

The 1939–1945 War

The whole nation was swept into the National Service Scheme and the ophthalmologists had to go in for mass production. After rather a sticky start the optical industry's full aid was enlisted. Thus by the end of 1941 every recruit was examined in the first fortnight of his preliminary training, and if he required spectacles the completed "job" could be fitted upon him at the conclusion of his examination. This necessitated opticians, lenses, spectacles, frames, etc., to be obtained to man and supply the optical sections.

There were some forty-eight optical sections in the United Kingdom alone and there were others at the ophthalmic centres abroad and with the Mobile Ophthalmic Units. Some idea of the organization required can be obtained when it is realized that the overall ophthalmic commitments were at the peak period some one hundred and eighty-one.

Gradually the set-up of the previous war had to be evolved again. Opticians and ophthalmologists had to be found. Nursing orderlies and nursing sisters trained for duty at the base ophthalmic wings of hospitals. St. Dunstan's played its full part and a special Eye Convalescent Hospital was organized. A fundus artist and special pathological arrangements had to be arranged. At home the inclusions of the great eye hospitals under the E.M.S. Service scheme enabled the transition of the nation from a peace-to-war footing to be carried out without a general disruption of the ophthalmic services.

Doubtless the official histories in the near future will tell the full story. But the following figures will give some idea of the work that the Army's ophthalmic specialists had to undertake.

It was necessary for 10 per cent of the National Service intake to be examined and refracted, and half these men had to be fitted with two pairs of spectacles on the spot. The ophthalmic battle casualty ratio was approximately 2½ per cent of all the men who were evacuated and reached the C.C.S. alive. We are extremely proud that there were only 500 men from the whole Empire to need the care and training of the various branches of St. Dunstan's at home and overseas. Wurdeman, you will remember, stated that in the First World War 67 per cent of all eyes injured were lost. In the Second World War only 37 per cent were lost from injuries from any type of enemy action or "battle accident." This was undoubtedly due to the policy of bringing the ophthalmic surgeons to the patient at the farthest forward position possible in the line of evacuation.

The mobile ophthalmic units had trucks on which they carried equipment for any major or minor operations required, for refracting and a complete optician's workshop. Thus they could deal with any ophthalmic problem and were sited at the first "bottle-neck" C.C.S. or 200 bedded hospital in the evacuation chain. Their job was to operate upon the urgent emergencies and to exhibit sulphonamides and antibiotics to all other cases. They also pre-

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vented the evacuation of refraction cases out of the Corps areas. These ophthalmic teams linked up with the other small "specialist units"—the facio-maxillary and neurosurgeons. They acquired the nickname of the "Trinity" and between them dealt with about 10 per cent of all battle casualties. After some slight breezes due to the feeling that they were poaching on the preserves of the Field surgical units, they in time took their rightful place in the surgical world. Christmas Day 1943 in Vasto was the date of this acceptance into the Mystery when there appeared on the Mess notice-board the message "Happy Christmas everybody even the —— Trinity. Signed, the F.S.U.s."

Much research went on in ophthalmology during the war: designs for visors, portable ophthalmic diathermy machines, small magnets, different shapes of steel-helmets, design of instrument-panels for tanks and aircraft, and protective goggles for troops overseas and for scanning and sun-searching, etc., in the Anti-Aircraft Command. Also much work went into the problem of better night vision. The problem of the so-called night-blind had been heightened for the urban population by a series of very dubious drug-house advertisements in the yellower press, so a considerable portion of the ophthalmologist's time was wasted by persons who didn't want to see for military purposes by day or by night. Fortunately an official iron-curtain was dropped on the problem of night-blindness-without-signs-of-organic-disease, and thereafter these men ceased to trouble the ophthalmologists.

Some 40 per cent of the battle casualties were the result of concussion injury, whilst the incidence of the non-magnetic intra-ocular foreign body did not rise much higher than in the 1914–18 War. The removal of the fragments from the interior of the globe by means of the posterior route proved an excellent operation, to which the figures quoted above on the loss of eyes provide a suitable commentary.

Ophthalmia was non-existent and real trachoma presented no difficulties although thousands of Levantine, Indians and Negroes were enrolled in the Pioneer Corps. The returned prisoners of war who had been in Japanese hands had suffered extremes of malnutrition and some hundreds showed the signs of a Nutritional Amblyopia due to the lack of first-class protein and the vitamin-B complex.

Many new Arms and trades were produced by the changes of the war and the Seven Visual Standards proved excellent in the ready sorting of men who would be visually capable or otherwise of carrying out such duties.

Post-War

Army ophthalmologists cannot be exactly said to be entering the doldrums again: they dealt with 134,000 cases for examination and treatment at the centres in the United Kingdom alone in the past two years. We are trying to keep up to the standard of the best work done in the war years and to continue spadework for future improvement. After all there is always Pulheems and the following picture of the infantryman-paratrooper of the next fifteen years is not too fantastic.

His plastic helmet would give lateral protection to his orbit and would

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incorporate a built-in earphone and a transparent plastic visor. He would use a throat-microphone and wear contact-lenses which would cover the sclera as a protection against vesicant gas. His lenses would do away with the need for spectacles and could be worn for days on end. He would carry a multipurpose pair of goggles with quickly interchangeable filters to protect against glare, snow, and the sun in A.A. duties. His pockets would contain an antibiotic ointment and he would have the equivalent of B.A.L. to cope with all gases that might injure the eyes. He would have a small infra-red apparatus to enable him to see well on night patrol.

The ophthalmic team working behind him again with the "Trinity" would have its own portable anæsthetic apparatus, X-ray machine and trace-elements to aid localize the intra-ocular foreign body, and a smaller powerful magnet and diathermy apparatus. The nursing officers would be present, forward in the chain of evacuation, and the opticians would be able to make quick-drying moulds of the eyes for contact-lenses, and could maintain the infra-red apparatus. Evacuation would be by air to the Base Ophthalmic Wing for more radical treatments.

The recruit whose records of refraction, ophthalmic lesions, etc., were known from infancy to the State Medical Service would also have been watched over by industrial ophthalmologists throughout his working life. So the recruit could be quickly made ophthalmically fit and then trained in night-fighting, and in the full use of his vision during his initial training period.

All the above may seem at first sight a little exaggerated, but some of the groundwork is already laid and it is up to the military ophthalmologists to see that progress is maintained.

Is it only fifty years since Omdurman?

[Yes—less than the span of a man's life.—Ed.]

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OTO-LARYNGOLOGY

BY

Lieutenant-Colonel W. A. D. DRUMMOND, *O.B.E.*, F.R.C.S.
Royal Army Medical Corps

THE progress of oto-laryngology in the Corps, although beset from time to time by difficulty, happily has been marked by a firm liaison with our civilian colleagues. It should be noted also that in time of war otologists of the Special Reserve and the Territorial Army have maintained and advanced the speciality.

In this country at the close of the nineteenth century oto-laryngology was, as a speciality, establishing itself. Interested clinicians gathered together the more inquiring and progressive physicians and surgeons to form the Laryngological and Otological Societies. Among these were two officers of the Army Medical Staff who, interesting themselves in the subject, contemplated its application to the Army. These two officers, Surgeon Captains George Abraham Moore and George St. Clair Thom, became Captains of "our Royal Army Medical Corps" on its formation on June 23, 1898. So, from the founding of the Corps, Moore the aspirant to laryngology and Thom the student of otology were at hand and keen to start the new speciality. The outbreak of the South African War, however, thrust aside for a time their hopes and ambitions.

At this period little specialized work was undertaken. In 1898 the total number of admissions for all entitled persons in the Army and residing in the United Kingdom was 1,036 while out of this number only ten operations were performed.

THE SOUTH AFRICAN WAR, 1899–1902

As the speciality was not yet recognized no aurist was appointed to the Army. The small amount of ear, nose and throat work undertaken was performed by general surgeons. Regarding this, Sir George Makins noted the following cases: Two of wounds of the antrum, two of the trachea, three of the pharynx and one of the larynx. Throughout the war only 3,965 other-rank non-battle casualties suffering from disease of the ear, nose and throat were admitted to military hospitals and of these 1,109 were invalided home. Traumatic rupture of the tympanic membrane having become recognized, was reported in a number of cases while otitis externa and media each formed one-third of the admissions for ear disease.

REORGANIZATION OF THE ARMY MEDICAL SERVICES, 1901

In 1901 a select committee drew up a scheme for the improvement of the Royal Army Medical Corps. Its essential recommendations were:

(*a*) The addition of 102 medical officers.

(*b*) The attachment of medical officers for periods of six months to a civilian

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teaching hospital, to enable them to qualify for further professional examinations, one being for optional subjects which included either Laryngology or Otology.

(c) The granting of an additional 2s. 6d. per day as Specialists' pay.

The committee were not unanimous in opinion for Sir Alexander Ogston, the Regius Professor of Surgery, Aberdeen University, pointed out that the scheme lacked a number of provisions including among other things the two following:

(1) It did not provide adequately such study leave as the advancing state of Medical Science now demanded, a need which was likely in future to increase; nor did it grant such liberal privileges in this direction as had been found necessary in the armies of other Great European Powers.

(2) It failed to provide for the training of medical officers by attendance upon civilian patients in all branches of their profession in order that they might become as skilful as their civilian brethren and so avoid the narrowing influences which act so injuriously upon medical officers who have to deal only with the treatment of soldiers and military officials.

The Years Between 1903–1913

When Major Moore returned from South Africa he was seconded to the Throat, Nose and Ear Hospital, Golden Square, where he came under the influence and guidance of Parker. His interest was awakened in bronchoscopy by Irwin-Moore, and this lead him to buy one of the first Brünning's bronchoscopy sets to be used in this country.

Captain Thom who returned to his old school and studied under McBride in the Royal Infirmary, Edinburgh, later introduced oto-laryngology into the Punjab and the North-West Frontier Province of India.

During this inter-war period thirteen officers qualified as specialists in oto-rhino-laryngology. In those days a specialist's appointment was not usually a whole-time duty. Captain Thom, Specialist in Otology, performed the duties of Adjutant of the Depot and, while so employed, qualified as Specialist in Laryngology and also in Rhinology. Captain S. L. Pallant was employed as otologist and in addition as dental specialist at the Royal Victoria Hospital, Netley. The Brigade Laboratory at Colaba was in charge of Captain J. G. Berne who was also the Specialist in Oto-rhino-laryngology.

The Great War, 1914–1919

On mobilization for the Great War all specialists in otology, as they were then called, were required to fill administrative or executive appointments. Major Moore, for example, Otologist at the Cambridge Hospital, Aldershot, was posted as O.C., Ambulance Trains, British Expeditionary Force, France.

The need for otologists was not yet envisaged, consequently no appointment as such had been made. Indeed, on mobilization, otologists were serving as R.M.O.s, surgical specialists and as combatant officers, nevertheless their specialist opinions were in constant demand by their medical colleagues. Major E. B. Waggett, R.A.M.C. (T), who in 1913 had been appointed the first Honorary

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Consultant Oto-rhino-laryngologist to The Queen Alexandra Military Hospital, was now serving as a Field Ambulance Commander. In the rest phases between battles he organized at his Headquarters a Divisional Ear Treatment Centre.

It was some months after the outbreak of war before it was realized that most general hospitals held large and steadily increasing numbers of cases of deafness and middle-ear disease. The necessity for aurists and for special ear centres was now apparent. By September 1916, aural surgeons were appointed to most general hospitals and ear treatment centres equipped with beds had been established in three of the hospitals in the Boulogne area. Major Sidney R. Scott, R.A.M.C. (T), was appointed Adviser in Aural Surgery to the British Expeditionary Force. In the Autumn of 1917, the Directors of Medical Services were stressing the need for aural surgeons to treat front-line troops and a number of aurists were then attached to C.C.S.s and to Field Ambulances to deal principally with ear cases. In the Near East reduction in the wastage of man-power was effected by posting aurists to appropriate sites on the Lines of Communication. Middle-ear disease was largely attributed to inadequate screening at the time of recruitment. Again and again it was found that quiescent middle-ear disease broke down under the physical stresses to which the front-line soldier was exposed. Many cases of deafness were the result of blast trauma. Functional or psychiatric deafness became a growing problem more especially as the treatment of it fell largely upon the aurist. Rupture of the tympanic membrane was the most common otological injury encountered.

The Interval, 1920–39

After the run down of demobilization it was found that the oto-laryngological cover for the Army, to say the least, was in a very meagre state. During the period of the Great War no regular specialist had been trained and the already qualified specialists as they became senior, were absorbed into administrative posts. This critical situation was met by the energetic co-opération of Major E. B. Waggett, *D.S.O., T.D.,* Senior E.N.T. Surgeon at Charing Cross Hospital, who had resumed his Honorary Consultant appointment. He not only undertook the training of officers but with his assistant, Mr. E. D. D. Davis, shared the clinical and operative work until an officer could be trained to take over.

After Major Waggett's retirement it was most fortunate that Mr. E. D. D. Davis was chosen to succeed him. To further the training of regular officers Mr. Davis obtained the permission of the Director-General, Sir Harold Fawcus, for an officer to be appointed as E.N.T. Registrar to his Department at Charing Cross Hospital. This was the first occasion upon which a serving officer held an appointment on the staff of a teaching hospital.

In Scotland the willing help of Dr. Douglas Guthrie was solicited not only to deal with the clinical and operative work, but also with the training of officers.

As a result thirteen officers were trained in the second inter-war period. Depletion, however, was still great, as by 1939 only six of these thirteen specialists were employed as otologists. Additional specialist cover for the Army was afforded, however, by the employment not only of temporary officers but also

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of a number of otologists who had been specialists in the Great War and who now gave their services on an "as required" basis.

THE WORLD WAR, 1939–1945

Of the six regular otologists employed in 1939 not one was engaged in the speciality by the end of 1940. At the beginning of the war each 600 (or over) bedded hospitals had an oto-laryngologist posted to its establishment. This allotment though adequate in number, failed in its purpose by want of administrative elasticity. Later, the shortage of specialists did not permit of this allocation so oto-laryngologists were appointed only to specific hospitals.

In 1941, in order to organize the Oto-laryngological Services of the Army, Lieutenant-Colonel Myles L. Formby was appointed Adviser in Oto-rhino-laryngology. This appointment was later upgraded to Consultant status.

In the Middle East the wastage of man-power days from infection of the ears alone demanded special measures for its reduction. The problem was undertaken by Major R. B. Lumsden who in the Base areas established ear treatment centres where soldiers suffering from chronic ear diseases could receive attention and treatment on an appointment system from a specially trained staff of low category personnel frozen for this particular purpose. In this theatre it was calculated that 8 per cent of all troops disembarking, 20 per cent of all new out-patients and 11·35 per cent of all admissions were suffering from diseases of the ear, nose and throat.

To cover a further shortage of specialists a number of able and experienced clinicians capable of supervising and assisting graded and specialist officers were appointed as Advisers in theatres of operation. Essentially their duties were clinical but in addition they advised their Medical Directorates how to employ most economically the available talent.

These appointments led to the development of the Pool System in which a quota of oto-laryngologists was allotted to the Adviser who was then responsible for organizing the ear, nose and throat work in his particular zone. Specialists were then given charge of ear, nose and throat cases in one or more hospitals along with those in the ear treatment centre.

Mobile oto-laryngological teams were formed to meet and solve two further problems. One was the demand for specialist services for forward troops just out of the line, who, while in action, carried on with partial deafness or a sinus headache but, during the rest period, sought advice and treatment. The other was the need of a specialist to visit hospitals and supervise ear treatment centres. Each mobile team consisted of: Oto-laryngologist 1, trained clerk-orderly 1, batman driver 1. The equipment was a specially devised set of instruments packed for travelling. Transport allotted was a 15-cwt. truck.

In 1944 the Oto-laryngological Services in India required co-ordination, to effect which Brigadier W. I. Daggett was sent as Consultant Oto-laryngologist. At the height of the war over 104 specialists and graded specialist officers were in active employment, the vast majority being drawn from the Special Reserve and Territorial Army. Major Dorothy J. Collier, F.R.C.S., the only woman specialist in oto-laryngology in the Army, saw service in the North African and Italian campaigns.

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E.N.T. Equipment

It was not until 1923 that a scale of ear, nose and throat equipment was designed. It was then listed as Appendix 28 of the Regulations of the Medical Services of the Army. Previously, since 1897 the following instruments had been held on the Loan Appendix:

Mackenzie's laryngoscope with three mirrors.
Bruton's auriscope.
Wilde's specula.
Blake's snare.
Politzer's bag and eustachian catheter.
Double tracheotomy silver cannula medium and large.
Probang double.
Guillotine tonsil.

In 1932, in order to meet the increasing scope of the speciality the equipment listed in Appendix 28 was revised and issued in its new form under Appendix 27 of the Regulations of the Medical Services of the Army. During the World War a further revision was made and equipment was provided in three scales, one for the operating theatre, one for the ward and one for the out-patient department. In addition there was the special travelling set. The present oto-laryngological equipment of the Army compares favourably with that of any modern teaching unit.

The Army Oto-laryngological Service, 1948

With the rapid demobilization of our civilian colleagues our strength is again very meagre but the fact that those who have recently left the Army feel it their patriotic duty to give us all the help and encouragement that is needed is most cheering. We are also fortunate in having one of our wartime Consultants, Brigadier Myles L. Formby, as the first Honorary Consultant Oto-laryngologist for the Army (1946).

It is now recognized that the Service oto-laryngologist must be given facilities to equal those granted to his colleague, the civilian consultant. The aim is that the trainee should prepare for the Diploma of Laryngology and Otology, that the graded officer hold this Diploma and that the specialist officer have the hallmark of one of the Royal Colleges. To achieve this the trainee is selected very early in his service and posted to an oto-laryngological centre of a military hospital. In addition he is attached as a clinical assistant to a recognized civilian teaching unit. During this period all encouragement to study for academic qualifications is given. Should he be posted for overseas' service directing contact is still maintained. On return from overseas he is posted for a post-graduate course to an otological teaching unit such as: The Royal Infirmary, Edinburgh, The Professorial Unit of Otology, Manchester, The Institute of Otology, London.

After this course, should he desire, every effort is made to post him to the military hospital where he began his specialist training so that he can renew his former professional and civilian friendships. After completing the Senior

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Course at the Royal Army Medical College, the graded officer is given a year's study leave which may be occupied in appointment as a registrar in a civilian hospital or in research work.

The Future

The attachment to a civilian oto-laryngological centre is not meant to be a temporary phase for a stated period but is intended to last throughout the specialist's Army career. It is not only the means of keeping him in active contact with the civilian aspect of the speciality but on retirement it also enables him to continue as a specialist in civilian life. Now that officers of the rank of Lieutenant-Colonel may continue to hold specialist appointments the present-day trainee can look forward, should he choose, to twenty-five years' professional career in the Royal Army Medical Corps.

In conclusion it can be pointed out that these progressive advances have remedied the defects stressed by Sir Alexander Ogston in the original scheme and one may look forward to the future with confidence.

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PSYCHIATRY

CONDENSED FROM AN ARTICLE WRITTEN BY

Brigadier A. TORRIE, M.B.

AND

Major R. H. AHRENFELDT

Royal Army Medical Corps

(*With Additions by the Editor*)

THE early developments in the treatment of mental disease in the Army—up to the opening of "D" Block, Royal Victoria Hospital, Netley—have been described in a recent article by Rosie. No fundamental changes were introduced until after the first World War when great advances were made in the treatment of mental illness.

Not until the recent war did Army Psychiatry as we now know it attain its present status and gain full recognition.

Prior to the War of 1914–19, and after it as well, for that matter, the Army Specialists dealt solely with the treatment of the insane and what were then known as "borderline cases." This term included the neurotic and psycho-neurotic group as well as the feeble-minded, psychopaths and the neurasthenics.

Nearly all the work was done at "D" Block. Here came all the cases of mental illness in England as well as patients from overseas. Its main function was to act as a clearing centre from which patients were either, (*a*) discharged to the care of their relatives, (*b*) certified and sent to the appropriate asylums (later, mental hospitals), (*c*) transferred to the medical wards as "non-mental" patients, or (*d*) returned to duty.

None of the patients at "D" block were certified which was an advantage from many points of view, particularly as the "stigma" of certification was avoided, an important aspect from the relatives' point of view. One of the main principles behind treatment was to enable the patient to recover sufficiently to be able to avoid certification. The officer-in-charge was allowed considerable discretion as to the length of time patients were retained under treatment. Until the war of 1914–19 the treatment of all mental patients was conservative. The now well-known forms of treatment—psychological and physical—were still in their infancy and the use of the padded room, seclusion and restraint still remained as part of the physician's armamentarium.

In 1907 "D" Block had been enlarged by the addition of a new infirmary ward, bright, cheerful and modern, but the atmosphere still remained that of a mental hospital.

THE WAR OF 1914–19

The experience of the first Battle of the Somme when several thousand soldiers were, in a few weeks, withdrawn from the battle zone on account of "nervous disorders" made it obvious that to deal with this waste some specific

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medical organization was necessary. One of the difficulties was an attitude of mind which held that it was not possible to differentiate cases of psychoneurosis from cases of "malingering."

Towards the end of 1916 a special "N.Y.D.N. Centre" was set up in each Army area for the treatment of such cases. This was largely on recommendations made by the Consulting Psychologist, C. S. Myers and the Consulting Neurologist, Gordon Holmes. At the same time a number of "neurologists" who were, in fact, "psychiatrists" were brought into the Army.

At first the tendency was to regard all these cases as "Shell Shock" postulating an organic basis (on the lines of the modern "post-concussional syndrome") and disregarding the psychological determinants which were, indeed, seldom recognized.

In a review of the position of Army psychiatry in 1920, Dr. C. S. Read—formerly officer-in-charge "D" Block—wrote as follows: "It is certain that as psychiatric medicine is having its importance more recognized in civilian life, the military authorities will have to develop their branch in the Royal Army Medical Corps, and by its scientific application do much to improve the mental status of the soldier. The sooner some officers become *thoroughly* trained in this speciality the better. The late war has given an enormous impetus to the necessity for active interest in psychopathic disorders and the lessons learnt should immediately instigate a line of organization by means of which the soldier's mentality can be judged accurately, so that his fitness for any particular form of service may be gauged. This would mean not only increased efficiency through elimination of the unfit but also increased efficiency by seeing that the soldier is psychologically suited for his particular work. Thorough psychiatric knowledge, too, would bring added justice in its train, as the delinquent is then seen in his right perspective. All frequent offenders, and certainly a large proportion of court-martial cases, should be mentally examined in order to get at the basis root of their anti-social acts, and so treat the offender and not the offence. This certainly has been a lack in the Service organization during the war, when organic neurologists with no psychiatric training have been called on to determine the question of responsibility of such men."

Following a Debate in the House of Lords in April 1922 the Southborough Committee was appointed by the War Office to survey the psychiatric problems of the war of 1914–19, and later issued its report. This Committee, having considered the evidence of combatant officers and medical witnesses, made a series of recommendations nearly all of which have the full approval of informed psychiatric opinion. The report stresses, in particular, the importance of adequate selective procedure in preventing psychiatric illness in the Armed Forces. It was emphasized that both executive and medical officers should co-operate in detecting mental instability, and that for this purpose they should receive special instruction in the management of men and in the nature of psychiatric disorder.

Between the Wars

With the advent of peace "D" Block again became the collecting and dispersal centre for all Army cases. It was the only special hospital and there

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were few fundamental changes in treatment to start with. However, as modern methods were introduced in civil practice they were taken up and used at "D" Block. The Army Specialists were given thorough and extensive training albeit particular stress was laid on the diagnosis and treatment of psychotic illness as well as on neurology. The specialty was not then divided.

The introduction of modern methods of treatment and a more modern approach was largely due to the initiative of such enlightened officers as Webster and Gall.

Malaria therapy for the treatment of G.P.I. was used in "D" Block about 1929 or 1930 when a very interesting series of cases was treated with, on the whole, satisfactory results. There were only a few as G.P.I. was never a very common disease in the serving soldier. One patient who, on admission, was hallucinated and deluded, recovered sufficiently to be employed as a chauffeur-gardener.

It is interesting to look back on the developments in hypnotic drugs during the last fifty years.

We were, at one time, largely dependent upon such as chloral and bromide, sulphonal, trional, tetronal, paraldehyde and morphia with or without hyoscine. As the newer hypnotics came into general use they were adopted in the Army. Recent years have seen a great change due, particularly, to the development of the barbiturates which are now used so extensively. Paraldehyde remains a stand-by in spite of its taste and smell.

One of the most recent methods of treatment is ether abreaction. Some of us had used it in the Army as long since as the war of 1914–19. The great difference was that we did not then use the word "abreaction."

The modern approach to psychiatric problems as the result of Freud's original work and subsequent work by Jung, Alder and the representatives of other schools of thought was not neglected but patients could not be retained long enough to justify deep analytical methods.

It must be remembered that the whole outlook on mental illness and psychiatric problems has changed in the last fifty years and a vast esoteric terminology has grown up. Amongst the simpler changes—"Lunatic Asylum" was replaced by "Mental Hospital." "Lunacy" has been replaced by "Mental illness" while there are many young psychiatrists who, amazingly enough, do not know that they were once called "Alienists." An outstanding change was the replacement of "Dementia præcox" by "Schizophrenia."

While not taking certified patients "D" Block still came under the supervision of the Board of Control and was visited by them. Such visitors were invariably of very great assistance. Their interest was much appreciated.

So "D" Block remained essentially a hospital for the treatment of the psychotic soldier with which aspect of psychiatry the specialists were mainly concerned.

All the mental nursing orderlies were trained there and it was recognized as a training school for the Certificate of Mental Nursing of the R.M.P.A.

In India, which remained the only overseas station with "mental specialists" there were, at first, but two appointments, North and South. Later there was one for each of the four Commands but two of these were I.M.S. officers.

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The main collecting centre was the well-known Mental Section at Deolali. The origin of the expression "Deolali Tap" is still in dispute but it is believed to ante-date the opening of the mental section. The section was chiefly a collecting centre for patients awaiting embarkation but it also took Southern Command patients for treatment. The most satisfactory form of treatment appeared to be embarkation, but more was done than that. At least three cases of G.P.I. were given malaria therapy, one with considerable success. The other two failed to take. The method used was subcutaneous, or intramuscular, the blood being taken from an infected donor—not a very satisfactory procedure.

There were small wards for mental cases at Rawalpindi, Karachi, Secunderabad and elsewhere but they were not very satisfactory. Some of the "mental wards" in the older hospitals appeared to have been designed for the detention of the more dangerous carnivora indigenous to India.

It had long been a rule that patients were detained in their Stations until sent for embarkation. This was gradually ignored and, whenever possible, patients were transferred to Hill stations from the Plains during the hot weather.

In 1933 the mental section at Deolali was transferred to the Military Hospital at Colaba, Bombay. This was a more convenient centre for embarkation. There were also more clinical facilities and the services of other specialists were more readily available for consultation. Parenthetically, the Specialist found it a more pleasant place in which to live and a more convenient place from which to tour. He and his predecessors had acquired an unholy familiarity with the railway station waiting room at Kalyan.

At Colaba all patients were put through a thorough investigation as to their physical condition. All were X-rayed to exclude cysticercosis and impacted wisdom teeth; W.R. and Kahn tests were done on blood and C.S.F.; stools were examined for cysts, etc.; blood films were examined and complete blood counts done in most cases. An attempt was made to introduce occupational therapy and, whenever possible, patients were treated in the medical wards free from restraint of any kind.

It had been well appreciated by the specialists in India that changes in the approach to mental illness were becoming more definite. They all realized that prevention was better than cure and it was felt that physical and mental hygiene were inseparable. About 1936 a scheme was submitted for the reorganization of the Mental Services in India laying stress on the importance of prevention. It was also proposed that an up-to-date mental hospital should be built at Poona and that there should be an Adviser to the D.M.S. on all matters concerned with mental health and the treatment of mental illness. However, for various reasons, amongst which finance loomed largely, things remained as they were.

It had, however, been possible, at least in the Southern Command, to establish a close relationship with the J.A.G.'s Branch in dealing with court-martial cases. This was proving its value and would have been extended had not the war intervened.

Some investigations had brought to notice the comparatively large proportion of young soldiers—in relation to the total numbers of mental cases—who broke down after a comparatively short time in India. This afforded an argu-

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ment for the introduction of some form of selection before sending troops overseas. The wisdom of sending "boys" to India at all was questioned.

In the United Kingdom some form of selective intake had been advocated shortly after the first World War. It seemed, more than once, to have been accepted in principle but nothing practical emerged. At the outbreak of the second World War the situation remained still far from satisfactory.

The Army had a few competent specialists and a limited number of trained mental nursing orderlies. For accommodation there was "D" Block at Netley. Overseas there were no specialists outside India.

The War of 1939–45

This saw a very dramatic advance. At first psychiatry was greeted with some suspicion and mistrust. The very word "psychiatry" was new to the Army where the attitude towards mental illness was still tinged, all too often, by the "looney bin" mentality.

It was clear enough, even before the commencement of the war, that the prophylactic approach to the problem of "war neurosis" was by far the most important, and that the scientific selection and placing of men would do more than anything else to avoid the development of widespread psychiatric disabilities. Unfortunately, it was not until much later that adequate measures were instituted. Despite the unequivocal conclusions and recommendations of the Southborough Committee, a pre-war attempt, in March 1939, to initiate the introduction of selection testing into the Army, met with failure.

A consulting psychiatrist, J. R. Rees, was appointed shortly before the commencement of hostilities and, after the outbreak of war, a psychiatric consultant, Henry Yellowlees, was also appointed for the Army in France. To commence with, military psychiatric cases, other than gross psychoses, were treated in the E.M.S. Hospitals and, towards the end of 1940, in No. 41 General Hospital in Somerset.

From April 1940 onwards, the Psychiatric Service was established on a Command basis with, in each Command, from three to ten area psychiatrists working under the Command Psychiatrist. A comprehensive out-patient service was built up and the whole system of in-patient treatment reorganized by the opening of military hospitals for military patients. Later there developed special Army hospitals for the treatment of the psychoneuroses.

In April 1942 a Directorate of Army Psychiatry was set up with H. A. Sandiford as Director. From then the Army psychiatrists dealt with such problems as: Psychiatric aspects of morale, discipline, training and equipment. Psychiatric aspects of recruiting, selection, grading, allocation and transfer of officers and other ranks. Clinics, hospitals, invaliding and liaison with the Ministry of Pensions, Ministry of Health and Boards of Control.

Overseas, G. W. B. James had become Consulting Psychiatrist in the Middle East where he did notable work. He was later Consulting Psychiatrist to the Army at Home.

E. A. Bennett became Consultant in India where he was responsible for building up a very fine team of psychiatrists who worked with the Army in

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Burma. It was here that the remarkably successful system of Divisional Psychiatrists working in forward areas, was introduced. The value of prompt, efficient early treatment was made very manifest.

Very fine work was done by psychiatrists in the Field in North Africa, Italy and, later, in North-West Europe but their story may be read elsewhere.

From June 1941, the Directorate of Selection of Personnel came into being and worked in very close collaboration with the Directorate of Psychiatry. When War Office Selection Boards were set up one or two psychiatrists were included in the establishment of each W.O.S.B.

Much specialized work of very great value was carried out by Army psychiatrists in such matters as the psychiatric aspects of discipline and morale, psychological warfare and the psychology of the enemy, psychosomatic disorders and the rehabilitation of the physically disabled as well as the civil resettlement of repatriated ex-prisoners of war. In passing, their best-known patient was, probably, Rudolph Hess.

All forms of modern treatment were used extensively: Continuous narcosis, analysis, narco-analysis, abreaction, suggestion, electric convulsive therapy, insulin and modified insulin. Early sedation in forward areas proved very valuable. The great value of constructive occupational therapy, as distinguished from merely diversional therapy, was fully appreciated and highly developed.

One very successful innovation was the organization of the Military Hospital at Northfield. This contained 200 beds for hospital treatment and 600 beds as a "training wing" where the rehabilitation of soldiers suffering from psychoneurosis could be carried out prior to their return to duty. This had been advocated as the result of experience in No. 41 General Hospital where it was felt that too lengthy hospitalization of psychoneurotic patients was definitely harmful.

Great importance was also attached to the question of responsibility and there developed a very close liaison with the J.A.G.'s Department. It is now the almost invariable practice to have psychiatric reports on all soldiers charged with serious offences.

It seems not inappropriate to conclude with a few remarks on the attitude adopted by the Army toward psychiatry. It was not to be expected that the Army would react to psychiatry and its implications in a manner very different from the civilian community and civil medicine. Thus, in the Army, from the very beginning of military psychiatry, "the Commanding Officer and the Regimental medical officer were the first to realize the possibilities of this aspect of medicine. Difficulties, however, there certainly were; and many of them will be commemorated in the half-friendly, half-doubtful nickname of 'trick-cyclists', which was bestowed on psychiatrists at an early date!" In the more detailed account which follows, some of these difficulties will be only too apparent. The position has been well summarized by J. R. Rees (1945): "Earlier in this present war we were often told that psychiatrists were the fifth-columnists of the Army, and this because they were advising the discharge of men who were obviously too dull or too unstable to soldier. The administrator who has to produce the 'bodies' and is quite out of contact with real live men is critical, and much

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opprobrium has come to Army psychiatrists because there has necessarily been a high discharge rate from psychiatric causes. The fighting soldier is in no doubt at all as to what kind of man he wishes to have with him. The further you get away from the front line the tougher become the comments, the more hints there are that everyone is trying to evade service, and that is and always has been a common experience of armies. . . . Any suggestion of change may arouse anxiety and so aggression, which the psychiatrist has to appreciate and counter, treating the situation clinically. Patience, tolerance, infiltration tactics, and skill in counter-attack, which psychiatrists learn through conditions like these, are of some value for the future. We cannot tolerate the retention of sickness and inefficiency in society just because we wish to avoid tiresome opposition and criticism of ourselves. It is very striking how few of the really intelligent and valuable leaders fail to appreciate the contribution of psychiatry, but we have to beware of those who become 'converts' and thus lose their capacity to help us with real criticism."

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RADIOLOGY (In arduis fidelis) 1898—1948

BY

Brigadier D. B. McGRIGOR, *O.B.E.*

The Jubilee of the Royal Army Medical Corps is coincident with the jubilee of the discovery of X-rays and consequently these notes cover the history of X-radiation from its beginning. The early days of X-rays (the all-seeing rays) were noteworthy for a widespread distrust but this apparently did not spread to those in the R.A.M.C. whose duty it was to develop this discovery. Evidence of this is shown in an early record of 1897 that X-rays were used with success by Colonel Beevor in surgery during operations on the Indian Frontier just one year after their discovery.

Some quite simple apparatus energized from batteries along with primitive tubes and photographic plates were the means of successful practical radiography. The examinations made were mostly for location of gross foreign bodies and the determination of the site and position of fractures. It is thus evident that X-ray help was accepted then as now in the Field where surgical administration calls for it. During one of these examinations conducted in a tent, several bullets from enemy marksmen penetrated the tent, fortunately without causing damage to staff, patients or apparatus. It needed much courage to continue under these conditions when each X-ray exposure took many minutes instead of the fraction of a second needed to-day.

Passing on to the South African War 1899–1902 a record of X-ray experiences during the siege of Ladysmith which was read at a meeting of the Röntgen Society in February 1901 will show the work of that period (Journal of the Royal Army Medical Corps, August 1903). Lieut.-Q.M. F. Bruce, R.A.M.C., in writing his experiences laid much stress on the necessity for independent generation of electricity as the use of charged batteries or cells had not been a success. He made several successful efforts to link up bicycles and small dynamos and during the siege made 200 X-rays and screened a large number of cases.

In the early part of the 1914–18 War, power supplies were still meagre and primitive as for example in No. 7 Indian Field X-ray Section which I brought from India to France (September–October 1914), a small ¾ horse-power oil engine with blowpipe ignition to charge the accumulators was the only source of power. It is interesting to note that the large casks of H_2SO_4 for the accumulators were carried on deck during the voyage under protest by the captain of the transport. This independent unit, such as it was, compared more than favourably with the units that were sent out with the original hospitals of the Expeditionary Force. The constant chase after independent power supplies suitable for X-rays has continued ever since, accompanied by many hopes and bitter disappointments in spite of frequent representations that this is a dominat-

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ing essential. The absence of suitable power supplies was in no way due to industrial laxity but on account of the fact that the use of suitable alternating current was not developed by the technical branches of the service.

In 1940 I found that exactly similar conditions pertained in the French Army Medical Service.

At the beginning of the 1939–45 War the same handicap meant that we had to rely in many cases on local supplies within the B.E.F. and those who knew the French system of transmission were despondent. The Army X-ray Advisory Committee (*see later*) made many recommendations but no funds were ever available to permit of their realization. These conditions as they existed caused an overwhelming demand at the outbreak of war and we had to face priorities and compete with other Services demanding similar equipment. Delays followed in consequence, but credit is due to the adaptability and energy of the British X-ray industry and somehow we were just able to obtain sufficient to keep going until bulk supplies became available in spite of setbacks such as the total losses in France and the calls made upon us to help Allied Forces. When new generators were sent to operational areas they had not been listed in authorized stores with the result that in many cases they drifted into other units or were filched for lighting purposes in offices instead of reaching their rightful places in the big hospitals. Forcible removal from the unwilling holders caused "gloom" in their offices.

In the small space at my disposal I cannot attempt to enumerate outstanding incidents in the many military operations both British and foreign in which X-rays were used successfully or describe the advances from coils to oil-immersed transformers; from the vagaries of the green gas tube to the reliable rotating anodes; from slow plates to super speed films; from laborious dangerous trial and error to high power and speed in comparative safety due to the adoption of the British Protection Committee's internationally accepted regulations; from the early and simple clinical deductions to the many certain diagnostic investigations and therapeutic treatments.

The R.A.M.C. has always been in the forefront in organizing X-ray teaching and there has been some form of Army X-ray school since about 1903. The teaching of X-rays up to the end of 1914 was the province of the X-ray attendant under the control of the Professor of Military Surgery there being no specialists until a later date. Among the many distinguished early teachers in the Corps the following are outstanding, Lieut. and Q.M. Bruce, R.A.M.C., prominent in Egypt and the South African War; later Mr. Worrad and then Mr. Henry. Amongst N.C.O. students who later became teachers were A. J. Walton (the first official Army X-ray instructor), J. Levey and W. Cairns. The three latter finished their Army service in X-ray work and have now retired after completing another career of equal length in civil X-ray work. Among the 1914–18 post-war N.C.O. students and teachers were Mr. Kenny and Mr. T. Longmore both well known in Civil Radiographic Science to-day.

The advent of the Army radiologist and systematized clinical training in radiology commenced with the establishment of the diploma in radiology of Cambridge University and the introduction of specialists in radiology in the

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R.A.M.C. promotion courses from 1920. The Cambridge diploma and the college courses were not, however, the first opportunity for Army officers to study X-rays as the Indian Medical Service established an X-ray Institute at Dehra Dun in 1909, under the able direction of the late Major Walters, I.M.S., and awarded a specialist qualification in electrical science after a short but very intensive and complete course. I had the opportunity of taking this qualification in February 1910 and was employed as a specialist in electrical science in India until 1914, in which year I proceeded with No. 7 Field X-ray Section to France. This was probably the first time that X-ray units had functioned outside India as independent self-supporting units and survived without being merged into the hospitals with which they worked (I do not think this was a really good system as the units were far too small to self-support). In 1921 I had the opportunity of qualifying as a specialist in radiology after the promotion course at the College and coincidentally obtained the Cambridge Diploma. I was then posted to the Queen Alexandra Military Hospital, Millbank, as the first Army specialist in radiology to be employed as such.

From that time onwards Army X-ray teaching was conducted on specialist lines by the radiologist at Millbank, nominally under the Professor of Military Surgery. Many distinguished officers and other ranks qualified as radiologists and radiographers and they usually took the corresponding qualifications D.M.R.E., or M.S.R., and filled appointments at other large hospitals at home and abroad. Radiology progressed rapidly between the wars and close liaison was kept up between the Army X-ray School, the Röntgen Society and later, the British Institute of Radiology. Two of the Army specialists have occupied the Presidential Chair of the Institute.

In 1926 the War Office formed the Army X-ray Advisory Committee consisting of civilian and military members—radiologists and physicists—under the chairmanship of the consulting surgeon to the Army as it is a War Office rule that all chairman of official committees must be serving officers. All aspects of radiological preparedness for peace and war were periodically reviewed. Home hospitals were regularly visited and inspected but this committee really failed throughout its life in its objective because no funds were made available by the Treasury either to establish or test the main technical proposals put forward.

In September 1939 the committee was disbanded as the Director-General decided to place radiology in a definite position by appointing a full-time adviser, later Consultant, in Radiology at the War Office to advise and correlate all matters concerning the speciality. I had the honour of being given this appointment and of carrying it through the war during which a very successful collaboration was instituted with A.M.D. 1 (Personnel), A.M.D. 2 (Accommodation) and A.M.D. 3 (Medical Supplies) as the principal co-ordinating executive offices. The enormous expansions in equipping new hospitals after Dunkirk was carried out by standardization of main equipment, the adoption of any worth-while development and the ordering of bulk supplies. The supply of radiologists and radiographers never failed as when qualified intake from civil

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life ceased to be available the Army X-ray school taught selected officers and men by intensive courses. Some 60 officers and 1,000 radiographers, along with many allied officers and men, passed through the school.

Each operational area had an Adviser in Radiology appointed to its staff and he formed the link between the consultant at the War Office and the specialists in his area. These Advisers correlated the clinical, technical and administrative problems locally on the one hand, and with the Consulting Radiologist at the War Office on the other. Numerous visits were made by the Consulting Radiologist to the Advisers and their areas so that first-hand knowledge of all happenings were seen as well as read. The work of the Advisers was very successful in spite of many local obstacles, frustrations, limitations of movement—some avoidable, some unavoidable.

The most interesting new development during the war was the result of an experiment in X-ray servicing tried out at first with the B.E.F. in France in 1939–40. This resulted in the organization of an X-ray Service and central X-ray Service store at the Royal Army Medical College under the supervision of the officers of the Army X-ray School. The service had the technical assistance of a highly qualified X-ray engineer and provided a shuttle service of urgent replacements—"new lamps for old"—for home hospitals and, later, overseas. In fact, the system was so successful that it led later to the organization of a similar type of unit known as surgical workshops. This further experiment finally led to the Army X-ray Servicing being engulfed by the bigger body and later taken over by the Technical Corps, R.E.M.E., etc.

This story does not touch on the many clinical and administrative advances in mass radiography and superficial therapy, that were undertaken but these and other omissions are dealt with in detail in the radiological section of the Medical History of the War.

Since the end of the war a consultative body (Army Surgery and Allied Subjects Advising Committee) has been set up and at the first meeting thereof the following radiological proposals were unanimously agreed and recommended for acceptance:

(*a*) To continue the radiological teaching centre at the R.A.M.College under the Adviser in Radiology.

(*b*) To care for the catalogued library of X-ray films, there illustrating war radiology and a corresponding library of slides of same.

(*c*) To develop clinical photography, black and white, and colour, mass miniature radiography and cinematography.

(*d*) To care for the museum of X-ray and auxiliary apparatus used in the Army Medical Service.

The successes of radiology in the late war were not confined to the efforts of any person or any group of people but were contributed to by all, the officers etc. successively of the Army X-ray School (1940–45), the Area Advisers, radiologists, radiographers and technicians of the Army Medical Service, the staff and technicians of the firms in the X-ray industry and the photographic film manufacturers.

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It is with great reverence that I acknowledge the willing help and wise counsel that was received at all times by the X-ray Services of the Army from the Consulting Adviser in Radiography to the Emergency Medical Service, Dr. A. E. Bardey, *O.B.E.*, D.Sc., F.R.C.P., etc., and from the Senior Consultant in Radiology of the American Army Medical Corps, Colonel Kenneth Allen, *M.C.*, M.D. The wide scientific experience and camaraderie of both these consultants made our work of liaison an easy and very pleasant task. I deem it an honour to have worked with them and to have travelled with the latter on many exciting and extensive tours of inspection of both the British and American Armies.

Finally I trust that the many personal experiences and reminiscences enumerated will be considered as justifiable merely to make the story as complete as possible.

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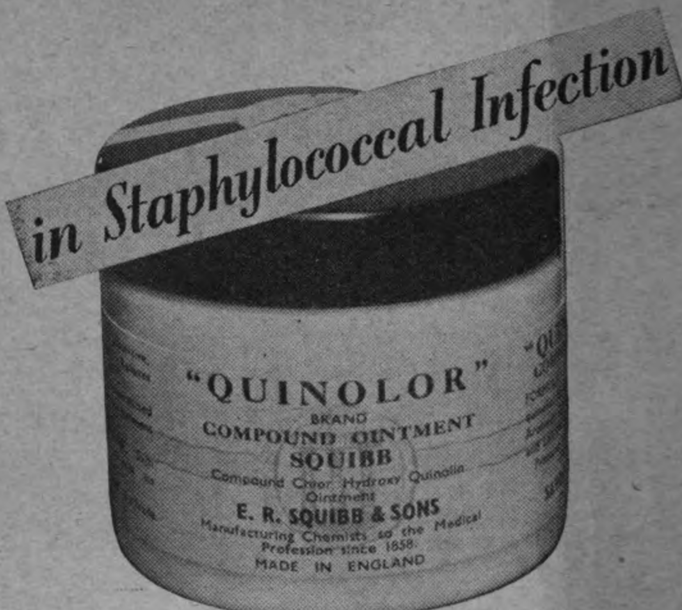

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ECHOES FROM THE PAST

Surgeon General W. G. N. MANLEY, *V.C., C.B.*

A Few Facts and Incidents in the Life of the Late Surgeon General W. G. N. Manley, *V.C., C.B.*, as told by Him at Various times, to his son,

Major J. C. M. MANLEY, *O.B.E.*, R.A. (Rtd.)

William George Nicholas Manley was born on December 17, 1831, in Dublin.

Early in life he was brought over to Barking where he was brought up and educated by his aunt.

He eventually "walked his hospitals" at St. Thomas Hospital before that hospital was transferred to its present site on the Thames Embankment.

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After this—"to gain experience" as he said—he went round the world as ship's doctor of a sailing ship. While crossing the Indian Ocean bound from the Cape of Good Hope to Australia, the ship's cook went mad and jumped overboard, having first loaded himself with the chains from the ship's pumps, thereby endangering the ship had she sprung a leak. On arrival at Perth, Australia, the whole of the forecastle crew deserted for the gold mines and the ship's officers, including my father, had to work the ship to New Zealand. He told me that furling frozen "royals" in a gale was not exactly fun as the sails made one's fingers bleed and broke the nails while trying to stow them against the yards.

On his return home from this voyage he was commissioned in the then Army Medical Department as an Assistant Surgeon, Royal Artillery. He served in the Crimea in 1854–55 and was present during the Siege of Sebastopol. For this campaign he received the Crimean War Medal with clasp for Sebastopol and also the Turkish War Medal for the Crimea.

He told me that during this campaign operations were very often performed without any kind of anæsthetic. The patient was usually given a round lead musket ball to bite on while his leg, for example, was being amputated above the knee. He told me that he had often seen a man spit out the bullet bitten in two halves. The stump was thrust into a bucket of boiling tar to stop bleeding and to cauterize the wound. Many, so he told me, were quite successful operations.

After the Crimea his next campaign was the New Zealand (Maori) War of 1864.

While disembarking troops from the transport in the Waikato River, a gunner fell overboard from one of the ship's boats while on its way to the shore.

My father saw this happen while he himself was waiting to disembark. He was at the time dressed in uniform consisting of a peaked gold-laced forage cap, frogged frock coat, riding breeches, jack boots and spurs. He was wearing a crossbelt and his sword in slings. Removing only his sword he dived overboard from the ship and swam to the gunner who, by this time, was floating partially submerged but held up by his overcoat rolled *en banderole*. The Waikato River is a fast-flowing river and after having knocked out the gunner because he was trying to climb on to my father in the water he managed to grasp the hand of the last man of a line of men lined out from the bank who had seen the accident. Getting ashore he brought his man round by artificial respiration but what pleased him most was that his gold watch was still ticking away merrily. For this rescue he was awarded the Royal Humane Society's Bronze Medal.

During the Maori Campaign at the engagement at the Maori Gate Pah, at Tauranga on April 29, 1864, he was detailed as doctor with the Reserve but as he said there was nothing to do he went in with the attacking party (Forlorn Hope) as he considered he would be more useful there. It might be mentioned here that he was then attached temporarily to the then 4th Foot (now the Suffolk Regiment). The attack was repulsed and driven out of the Pah. While lying down behind a slight rise a man was hit and my father went to attend to him. Wishing to give the wounded man some brandy he found that his water bottle

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strap had been cut by a bullet earlier on and the bottle had dropped off. He had felt this happen while in the Pah but had taken no notice of it. In order to recover the bottle he went back again into the Pah to look for it. Here he found a number of our wounded, among them Commander Hay of the Royal Navy who was mortally wounded. He removed him and many others under heavy fire. He was the last man to leave the Pah. When the action was over he was sent for by General Chute who commanded the British Force. My father told me that he was expecting to be censured for leaving the Reserve without orders but was astonished when the General told him that he was recommending him for the Victoria Cross.

He told me a curious story of an incident that happened during the campaign. The colonel of the 4th Foot was not popular with his regimental officers. This was apparently more or less at the end of the days of "purchase." As my father was only attached to the regiment the officers asked him to draft a letter for them which they all signed, in which they set forth the colonel's shortcomings. This letter was duly delivered. A few days after the colonel asked my father to come and see him privately. Thinking that the colonel had discovered the originator of the letter he was mentally preparing his excuses when to his surprise the colonel told him of having received a letter from his officers and requested my father to help him to draft an answer to it as he, my father, was not one of the regimental officers but only attached to the regiment and therefore the only officer he could consult with. My father told me that he thought it would be politic if he got a transfer to another unit before anything leaked out about the incident. This, he said, he managed to do.

After peace was made with the Maoris my father with a few other doctors were given the job of attending to the Maori wounded. He told me that one old Maori Chief died in his arms and his last words were "How sweet is man's flesh."[1] My father was made a chief by the Maoris and received the necessary chief's regalia consisting of a feather cloak, a paddle, an ebony battle axe and another battle axe made from a thigh bone with sharpened shark's teeth inset into its edge.

My father's next campaign was the Afghan War. He never told me a lot about this campaign but apparently he saw quite a lot of fighting in the Khyber. He received the Afghan War Medal for this campaign.

His next campaign was the Franco-Prussian War of 1870–71. He was sent over with the British Ambulance provided by The Order of St. John of Jerusalem and the Red Cross.

In this Ambulance, except for the doctors and a few British, the personnel were mostly Frenchmen enrolled after arrival on the Continent. The Ambu-

[1]The Maori name for human flesh was "Long Pig." I once met an aged Maori who admitted that he had, in his young days, eaten human flesh which he likened to very sweet pork. The Maori were never habitual cannibals but, in the old days, ate, ceremonially, of the flesh of enemy warriors killed in battle so that they might thereby absorb some of their valour. There were no indigenous mammalia in New Zealand and the Maori had never tasted any other form of flesh until the introduction of pigs by Captain Cook.—ED.

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lance operated with the advancing Germans. He told me that it made it rather difficult on account of these French personnel. I am not quite sure but I believe the Ambulance reached the German front via Brussels.

It was after the battle of Artenay, south of Orleans, that while at work operating on wounded on a kitchen table in a ruined farmhouse—all anæsthetics having given out—a German Staff Officer came in to tell him that the German General—I forget his name now—had recommended him for the Iron Cross of Prussia for saving the life of a German soldier in the battle which had just taken place.

As far as I can now remember he told me this German soldier had been caught by French crossfire and had been hit in the region of the femoral artery. On a call for a doctor, my father went forward with his orderly, a Frenchman and lay down beside the wounded man and got his thumb on the artery. He asked the orderly to give him a tourniquet from the box or bag he carried. The orderly was lying on this and was experiencing a bad attack of funk. After repeated requests for the tourniquet my father threatened the orderly that, if he did not hand over the tourniquet pretty quickly, he would release the artery and make the orderly stand up and hold him there and allow the wounded man to bleed to death, and would have the orderly shot if they both managed to get out alive. This threat produced the tourniquet from the orderly who immediately bolted for cover. My father having fixed up the wounded man then proceeded to carry him to cover on his back.

Another interesting fact which I understand from my sister, who has apparently seen it in the records of the *British Medical Journal,* is that my father during this campaign performed one of the first, if not the first, operation for the removal of the appendix. As far as I can remember the patient was a German soldier and the instruments used were a sharpened kitchen knife, some safety-pins, a buttonhook and a crochet hook. I may not have got these various articles quite right but what was used was equally crude. For this campaign he received the Iron Cross of Prussia, the Bavarian Order of Merit and the German War Medal of 1870 and was made a Knight of Grace of the Order of St. John of Jerusalem. From the French he received the Cross of the "Societe Francais de Secours aux Blesses."

When the siege of Paris was raised the first convoy of supplies for the people of Paris was arranged and sent in by the British Red Cross. My father, riding the leading pair of horses of the first wagon, led the convoy in behind two German Uhlans. Thus he was the first man into Paris other than Germans after the siege was raised. The Parisians, so he told me, completely devoured and demolished the convoy by distributing the supplies of food, eating the horses, breaking up the wagons for fuel and cutting up the harness to repair footwear and the like. He told me that his personnel had difficulty to keep their own clothing.

My father's fifth campaign was the campaign in Egypt against Arabi Pasha in 1882. At the time he was P.M.O. the Herbert Hospital, Woolwich and the force embarked at Woolwich Dockyard and sailed for Alexandria. My father told me that during the voyage his charger, a wall-eyed grey, was boxed in a

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travelling stall on the main deck. As the vessel rolled the breast bar of the stall became unshipped, the horse slid out and went head first down through the open hatchway and landed on the guns down below in the hold. He was got up unhurt and carried my father all through the campaign and eventually returned with him to England at the end of the war. My father received the Egyptian War Medal with clasp for Tel-el-Kebir, the Khedival Bronze Star for the Egyptian War and the Star of the Turkish Order of the Osmanieh.

I think it was after the Franco-Prussian War that he invented the first wheeled hand ambulance. This originally consisted of an ordinary stretcher fitted to and detachable from a two-wheeled framework. The wheels and framework were made for him by a coachbuilder in Brussels. The design and idea he later gave to the Order of St. John of Jerusalem and the present wheeled ambulances used by the Metropolitan Police and other Police Forces are a development of his original idea.

My father retired from Active Service in 1883 but when the Medical Services were being organized for the Boer War he was asked by the War Office to assist in this. As he had been retired for some years he refused. At the same time he mentioned that his two eldest sons were both fighting as Gunner Officers in South Africa, the third son was fighting as an Engineer Officer at Malakand on the North-West Frontier, the fourth son was fighting in China as a Royal Marine Light Infantry Officer on "H.M.S. Dido" and the fifth son, myself, was a Gentleman Cadet at the Royal Military Academy, Woolwich, and he thought that that was a very fair contribution to the country's services.

On retirement he was granted a Meritorious Pension of £100 per annum and at the time of Queen Victoria's Jubilee he was decorated by Her Majesty with the Insignia of a Companion of the Most Excellent Order of the Bath. In his photograph this Order can be seen near his left shoulder strap and above his cross-belt. Her Majesty pinned it on there and he said it should always remain where Her Majesty had pinned it.

Although he had taken part in no small way in five major campaigns he told me that during all these wars he had only once loaded his revolver but had had to unload it and put it away as he was too busy attending to casualties.

He died on November 16, 1901, at No. 3, Lansdown Terrace, Cheltenham, as a result of catching a chill.

He was never wounded or even scratched.

I think it is probably unique for a British Officer to have gained the Victoria Cross, the Iron Cross of Prussia, and the Royal Humane Society's Medal during his Active Service in Her Majesty's Forces.

I attach a description of the various medals and decorations he is shown wearing in the accompanying photograph.

This photograph shows him in the uniform of a Surgeon General Army Medical Department attached to the Royal Regiment of Artillery.

The following is an extract from page 183 of a book, entitled "Heroes of the Victoria Cross," by T. E. Toomey:—

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"ASSISTANT SURGEON WILLIAM GEORGE NICHOLAS MANLEY
(now Surgeon-General, *C.B.*), *Royal Artillery*.

At the Maori Pah, Tauranga, New Zealand, on April 29, 1864, Doctor Manley most devotedly and nobly risked his life in his efforts to save that of Commander Hay of the Royal Navy, and many others. He volunteered to accompany the storming party into the Pah. Here Commander Hay was mortally wounded, and when removed he followed, amid a hail of lead, to attend upon him. This done he again volunteered to go into the Pah in search of wounded. All being over, with many found there, Doctor Manley was the last man to quit it. He is one of the four V.C. officers who possess the Royal Humane Society Medal, for saving the life of a man of the Royal Artillery in New Zealand on July 21, 1865. For service with the British Ambulance 1870-71, Dr. Manley has received the Prussian Steel War Medal, The Iron Cross, and the Bavarian Order of Merit."

The Description of the Orders and Medals in the Photograph of Surgeon General W. G. N. Manley, *V.C., C.B.*

On the Right Breast:

Nearest the shoulder: The Cross of the "Societe Francais de secours aux blesses."
Next to it: The Bronze Medal of the Royal Humane Society.

Round the Neck:

The White enamel Maltese Cross of a Knight of Grace of the Order of St. John of Jerusalem.
Below: The Green enamel and gold Star of the Turkish Order of the Osmanieh.

On the Left Breast:

Above the Crossbelt: The white enamel and gold Maltese Cross of the Insignia of a Companion of the Most Excellent Order of the Bath.
Highest Row of Medals: Reading from left to right as you look at the photograph:
- The Bronze Cross of the Victoria Cross.
- The Crimea War Medal with clasp for Sebastopol.
- The New Zealand War Medal.
- The Afghan War Medal.
- The Egyptian War Medal with clasp for Tel-el-Kebir.
- The Turkish War Medal for the Crimea.
- The Bronze Khedivial Star given by the Khedive of Egypt for the Egyptian War.

Lower Row of Medals: Reading from left to right:
- The Iron Cross of Prussia.
- The White enamel and gold Bavarian Order of Merit.
- The Steel German War Medal (1870–71).

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MALARIA AND THE ARMY

BY

Major T. M. W. D'ARCY, M.B.
Royal Army Medical Corps

Introduction

Great reductions in the strength of the Armed Forces have taken place during the past two years and further reductions are anticipated. It is, therefore, as important now as ever it was during the war to conserve the health of the troops and to keep at a minimum the amount of preventable sickness if the best use is to be made of the available military man-power.

In the tropics and subtropics malaria is one of the chief causes of admission to hospital. The curtailment of this wastage is the responsibility of every officer and man. The Medical Services by education in the preservation and advancement of health can show the way to attain this objective. By the institution and supervision of malaria control measures they can make the way easier, but in every case final success will depend upon individual effort.

During World War II the conquest of malaria was an essential preliminary to the defeat of the enemy in certain theatres of military operations. So great was the necessity to protect the troops from the ravages of the disease that highly elaborate and comprehensive anti-malarial organizations, modified to deal with the malaria problems and the type of warfare peculiar to the terrain concerned, were instituted in the various commands affected. The highly trained scientific and technical staffs belonging to these organizations were available, not only to advise unit and formation commanders concerning the malaria situation, but also to initiate, carry out and supervise the multiplicity of schemes aimed to reduce to negligible proportions the malarial hazards confronting the troops. Labour, equipment, and supplies on a scale never before thought of in the military control of malaria were mobilized to fight the disease. The discoveries by teams of specially employed research workers in this country and in the U.S.A. were made available and applied to the conditions in the field as soon as their efficacy was determined. Thanks to the many concerned malaria was overcome for the time being and the way to victory was made easier.

Since the end of the war the anti-malarial organization has been dissolved. Malaria laboratories and control units have been disbanded. The medical responsibility for malaria prevention now rests directly, as it did before 1939, on the hygiene authorities and on whatever assistance they can call upon in the malarious stations overseas.

Unlike yellow fever, the other important mosquito-borne disease, in which one inoculation of a potent vaccine will give complete protection for four years

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and in many cases renders other means of prevention unnecessary, no such simple single method has yet been discovered for the control of the protozoal infections. The discovery of the newer insecticides and synthetic drugs, although making certain lines of approach to malaria prevention more successful, has not simplified the way to malaria eradication. The time-consuming and laborious methods of survey and control used by Ross and the pioneers who followed him are just as essential to-day if malaria is to be controlled scientifically and economically.

In order, therefore, to meet our present malarial commitments, the high standard of malaria control achieved during the war years must be maintained. It is the purpose of this paper to give an outline of the means at our disposal whereby this objective may be attained.

The principles of military malaria prevention and their practical application are described. The duties of the various medical officers, who may be immediately concerned when malaria is prevalent, are mentioned in brief. A scheme is set out which may serve as a guide to assist those who may be concerned with the management of an outbreak of malaria. For the sake of completeness two appendices, referring to entomological methods and office organization, are included. The subject is viewed chiefly from the angle of the Deputy Assistant Director of Hygiene (D.A.D.H.) because in the absence of a malariologist or a station anti-malaria officer, he will be directly concerned whenever an outbreak of malaria occurs. It will then be his duty to visit the locality, inquire into the causes and advise as to preventive measures [1]. A brief account of the transmission of malaria is included in the next section in order that certain points in the text may be made clearer.

The Transmission of Malaria

In order that malaria may occur there must be a reservoir of the parasite, a carrier, and a susceptible individual. This is the chain of infection.

The reservoir consists of humans with the sexual stages of the parasite circulating in the peripheral blood. In stations overseas the local inhabitants, and especially the small children, constitute the main reservoir.

The carrier is a female anopheline mosquito which has access to the human reservoir. She must be a species which will feed readily on humans and one in which the parasite will develop. Local conditions must be such that she can multiply readily and live long enough for the parasite to go through all its stages in the mosquito. The temperature range must be suitable for the parasite.

The susceptible individual is a person who is not resistant to infection. To contract malaria he must be bitten by an infected mosquito.

The Principles of Malaria Prevention

A. *The Military Aspect*

The approach to the problem of malaria prevention in the Army is simplified in that the population concerned is basically fit, more subject and accustomed to discipline, and, except when military families have to be considered, is composed of a limited age range. In addition, accurate morbidity statistics

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are obtainable which enable the effects of any control measures to be promptly determined.

There are certain disadvantages. A military population is not always static. In many cases anti-malaria measures must be maintained when the troops are in transit. They often have to be instituted at short notice and be of a temporary nature. Small scattered groups or detachments, whose protection is as vital as that of the main body, may have to be considered. Under these conditions and on active service more reliance has to be placed on individual co-operation than would be necessary or practical among a civil population.

B. *The Army Policy*

The prevention of malaria in the Army can be based upon three considerations in the following order of importance:

(1) Freedom from Infection: Troops and their families must not be permitted to become infected if at all possible. This is the ideal at which to aim and is prevention in its purest sense. It includes the avoidance of malarious areas, the establishment of control measures before the risk is encountered, and the education of all in the methods of personal hygiene.

(2) Eradication of the malarious focus: Circumstances may be such that malaria is taking a toll of the military man-power and undermining the health of the troops and their families. Steps must now be taken to remove the source of the infection by the prompt institution of control measures.

(3) Maintenance of efficiency: When for military or other reasons the above conditions are impracticable and infection cannot otherwise be prevented, the use of drugs, to prevent the disease or to maintain it at a subclinical level, may have to be employed.

C. *The Means of Prevention*

Malaria can be transmitted successfully under conditions in which the many ætiological factors vary in character from place to place. In prevention, therefore, no hard and fast rules can be laid down which will apply to each and every problem. Before any plan to combat malaria can be put into force, a survey of the malaria situation is essential in order to determine the most appropriate line of action. A malaria survey is always the first step to be taken in any campaign against malaria [2], and for this reason is included in the following classification of the means at our disposal for the prevention of the disease: (*a*) Survey; (*b*) Control of the mosquito; (*c*) Control of the parasite; (*d*) Control of the human factor.

(*a*) *Survey.*—A malaria survey is an examination of all the ascertainable factors likely to determine the occurrence, spread, and effects of the disease in a given community. The thoroughness with which this can be done will depend chiefly on the military situation, the size of the area, and on the time, staff, equipment and laboratory facilities available. It is convenient to consider a malaria survey as consisting of two parts:

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(1) A general investigation which will of itself yield information of considerable value. It must be carried out in every malaria survey and is always a necessary preliminary to further investigation. The methods employed are those that fall within the scope of every hygienist. They include the usual methods of investigating an infectious disease as well as the application thereto of the more widely known facts of malaria transmission such as the average duration of the incubation period, the broad outlines of the life-cycle of the mosquito, and the fact that the risk of infection is usually greatest during the hours of darkness.

(2) A special investigation is necessary to determine the finer epidemiological points which may have an important bearing on the prevention and control of the disease. It is also necessary whenever it is intended to take offensive action against the mosquito in order that the most suitable anti-mosquito measures may be applied when and where they are likely to do most damage. For a special investigation a highly trained and well-equipped staff is essential as special methods of procedure and technique may have to be employed. A special investigation may be required to consider:

- (i) The identification of the various mosquitoes in an area. The determination of the chief vector by dissection and precipitin tests and its precise habits in all its stages.
- (ii) The determination of the intensity of malaria in an area. The presence or absence of immunity in the local population. The study of the effects of the disease on social, economic and other human conditions in so far as they affect the Army.
- (iii) The elucidation of facts outside the scope of a general investigation.

The part played by a special investigation in the institution of a general anti-mosquito campaign is described in Appendix I.

(*b*) *The Control of the Mosquito.*—In an anti-malaria campaign, measures directed towards the breaking of the mosquito link in the chain of infection are those likely to be accompanied by the most success [3], and for this reason will be discussed in detail.

These measures may be classified as offensive or defensive depending on whether they are concerned with the liquidation of the mosquito or her exclusion from a human blood meal. In theory, the prosecution of one or other course should result in the disappearance of the disease, but in practice this is rarely possible and one approach has to be supplemented by the other.

The conquest of malaria in Brazil in 1940 is the only record in history where vigorous anti-mosquito measures brought about the eradication of the disease by the total extermination of the vector, *Anopheles gambiæ* [4].

Wherever malaria is prevalent the vector population must invariably be large [5]. Protection against the bites of mosquitoes to the exclusion of all other measures will not result in freedom from the disease [6], especially where the number of persons at risk is large.

On the other hand, the complete annihilation of an anopheline population is never a practical proposition from the military point of view. The best that

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can be expected is a diminution in the numbers of mosquitoes to such a low level that the risk of infection will be reduced accordingly. Superimposed protective or defensive measures ought then to be sufficient to keep the incidence at a minimum.

In the Army, malaria prevention depends chiefly on the combination of these two means of mosquito control—the proportion contributed by each depending on military circumstances.

In Table I are set out only those measures which have been found most useful in military practice and are of general application. A fuller description is given below.

TABLE I.—MOSQUITO CONTROL. (1) *Offensive Measures*

A. Measures directed against the adult stages of the mosquito.
- (*a*) Immediate Killing.
- (*b*) Delayed Killing.

B. Measures directed against the aquatic stages of the mosquito.
- (*a*) Temporary measures.
  - (i) Oiling.
  - (ii) Dusting.
- (*b*) Permanent measures.
  - (i) Filling-in.
  - (ii) Drainage.
  - (iii) Clearing.

(2) *Defensive Measures*

A. Those for which the individual soldier is responsible.
- (i) Nets.
- (ii) Clothing.
- (iii) Repellents.

B. Those for which the military authorities are responsible.
- (i) Siting.
- (ii) Screening.

Measures directed against the adult stages of the mosquito consist chiefly in the use of insecticidal solutions in the form of a spray. The habits of the mosquito attacked must be understood so that the spray may be applied where it is likely to be most effective. In all cases not only must the area to be protected be treated, but also, where possible, the zone outside to a depth equal to the effective flight range of the particular mosquito concerned. In some cases where the vector is a strong flier, or where the military units are greatly dispersed, this zone might cover 9 or 10 square miles.

For immediate killing a fine spray containing substances, such as the pyrethrins, which are rapidly toxic to mosquitoes, is used. The spray is delivered in the form of a fine mist.

The best results have been obtained against the domestic species of mosquitoes in their daytime shelters such as barrack rooms, native houses and tents. This is one of the most successful means of cutting short an outbreak of malaria [7]. It is also employed in malaria control schemes before the other methods of mosquito destruction have had time to become effective. It is the method used in the disinsectization of aircraft, motor vehicles and railway trains which may import mosquitoes from malarious areas.

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Delayed killing: The scope of spray killing has been extended by the introduction of DDT and Gammexane. Mosquitoes landing on surfaces treated with these substances are killed in a short time. The surfaces retain their lethal effects for many months. It is thus possible to treat the daytime shelters of the wild species as well as all other surfaces, both indoors and outdoors, where mosquitoes may rest for even a brief period. The effect of such sprays depends among other things, on the species of mosquito concerned, on the strength of the solution as well as the solvent used, on the character of the surface treated, and on the local climatic conditions. Much work remains to be done before the best methods of use of these substances can be stated, but the present use of 5 per cent solution of DDT in kerosene, despite its obvious disadvantages such as fire, has proved to be an inestimable boon to the Army in malarious areas.

Temporary measures directed against the aquatic stages of the mosquito are concerned chiefly with the destruction of larvæ and pupæ by the application of chemical substances to the surfaces of breeding places. To be effective, treatment must be carried out at least once a week and, as in the case of spray killing, must be extended beyond the limits of the area to be protected.

A suitable oil applied as a fine spray forms a film on the surface of water which kills larvæ and pupæ by suffocation and poisoning. Oiling is indicated for all collections of water which are free from vegetation and are not used for drinking purposes. The most suitable means of application is by a knapsack sprayer, but for small collections of water oil may be applied by means of a brush.

Dusting may be used where oiling is contra-indicated, as, for example, in the case of reservoirs, wells and cisterns. It is indicated for the treatment of collections of water where there is vertical vegetation, such as grass, reeds, and rice, which would prevent oil from spreading. In the case of rice fields, dusting is particularly recommended as oil has a deleterious effect on vegetation. The dust most commonly used is paris green (a double salt of copper containing arsenic) which floats on the surface of the breeding place in the form of fine particles and poisons larvæ by ingestion. For use it is diluted with some inert substance which will also float, such as powdered road dust, or charcoal. It is applied in the form of a fine cloud by means of a rotary blower. In the strengths commonly used (1 part paris green to 19 parts of diluent) it does not render the water poisonous to man.

Permanent measures directed against the aquatic stages are concerned with the complete removal of mosquito breeding grounds. This may not be possible in every case and all that may be achieved is the reduction in the size and number of breeding places to such an extent that temporary measures require less labour and materials. The initial cost of permanent measures is usually high but once established recurrent expenditure is low. Permanent measures, in spite of being so called, usually require periodic attention.

The chief indications for anti-malarial drainage are the removal of seepages and the reduction in the amount of surface water. All drainage schemes require engineering advice and supervision, but medical surveillance is always neces-

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sary to ensure that drains are constructed and maintained in such a manner that mosquito breeding is not encouraged.

The filling-in of breeding places is an obvious means of control but one which entails much labour. It is an important anti-malarial measure in countries such as tropical Africa, where the chief vector is a rain-water breeder. In these countries it is the only satisfactory method for dealing with small holes in the ground, such as footprints and car tracks in which prolific breeding may occur.

The clearing of jungle, bush or vegetation by exposing breeding places to the sun is indicated in countries where the malarial mosquitoes are shade-loving species. Care must be taken that a sunlight breeder does not become established. Clearing also helps to dry up small breeding places and make them more accessible for temporary treatment.

Defensive measures, properly carried out, in the presence of an effective anti-adult and anti-aquatic campaign, will reduce the likelihood of contracting malaria to negligible proportions.

Mosquito nets are the most valuable of these measures. They protect the sleeper during the hours when most malarial mosquitoes are active.

The next most valuable defensive measure is the use of anti-mosquito clothing during the hours of darkness when one is not in bed. Such clothing consists of a shirt buttoned at the neck and wrists, and long trousers with gaiters or mosquito boots. The surface on which a mosquito can feed is thus reduced enormously.

The exposed parts of the body such as the face, ears, neck, and hands are protected by the application of chemical substances, known as repellents, which deter mosquitoes. Di-methyl phthalate is one of the newer repellents and under adverse conditions such as severe sweating will give a very high degree of protection from mosquito bites for at least ninety minutes. Repellents are specially indicated in intensely malarious areas and for the use of personnel doing duty at night such as guards, telephonists, and drivers. Repellent solution should be taken inside one's mosquito net in case one has to get out of bed before dawn.

A big advance in malariology was the use during the war of veils, gauntlets and oversocks made of 3/8-inch netting and impregnated with di-methyl phthalate. The netting was carried in a wallet of absorbent material which was impregnated with repellent once a week. Such netting when worn over the head, hands, forearms and feet, when the boots were removed, will repel mosquitoes throughout the night and for at least seventy-two hours [8]. The size of the mesh was such that skin ventilation, visibility and hearing were hardly affected and yet a mosquito could not land on the skin without coming in contact with the impregnated netting. Troops on active service were thus able to sleep at night with safety and unencumbered by the ordinary mosquito net. This should prove a valuable means of protection for those travelling in trains at night through malarious areas.

Sites for camps should be situated as far as possible from obvious mosquito breeding places and from places they are likely to frequent such as houses and

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native villages. The ground selected should have good natural drainage in order to limit the necessity for subsequent anti-aquatic measures.

The screening of windows, doors and all other apertures in barracks, canteens, messes and family quarters with wire gauze which will prevent the entry of mosquitoes is recommended for all permanent buildings in malarious countries. Life indoors is made less tedious by obviating the necessity for anti-mosquito clothing and the periodic application of repellents.

(*c*) *The Control of the Parasite.*—Suppressive treatment is so far the only method by which malaria has been controlled successfully by the use of drugs. It may be defined as the prevention of the development of symptoms by the continued administration of drugs. Military control by this means has been put on a sound basis by the work of Brigadier Hamilton Fairley [9]. He showed that the administration of 0·1 gramme of mepacrine for fourteen days before entering a malarious area and during the whole period of exposure would prevent the development of symptoms even though the persons concerned were harbouring the parasites. If this treatment was continued for a further four weeks after the cessation of exposure, all malignant tertian infections incurred would be completely cured, but benign tertian infections would eventually manifest themselves. Under similar regimes of mepacrine treatment in the Italian [10], Burman [11] and Far Eastern [12, 13] Campaigns, the forces concerned mantained themselves in the field with a very low malarial attack incidence, in spite of the lack or incompleteness of other anti-malarial measures.

There are few uses for suppressive treatment in the peacetime Army. In most military stations anti-mosquito measures should be sufficient to keep the incidence of the disease at a minimum. Only in training should its use normally be necessary.

Suppressive treatment with mepacrine has many disadvantages. An enormous amount of administration, organization and individual supervision is required to ensure that the drug is taken daily by all concerned. If suppressive treatment breaks down there is the difficulty of tracing the source of the infection on account of the inability to determine accurately the time of infection. Toxic reactions occur and though relatively uncommon give rise to greater concern in a peacetime station, where troops families might have to be considered. Finally suppressive therapy may not be sufficient to control the disease in every case as Hamilton Fairley has recently shown that certain strains of the parasite may show resistance to mepacrine [14].

Paludrine, discovered in 1944 by Curd, Davy and Rose [15], appears to have many advantages over mepacrine in the control of malaria. The researches of Maegraith *et al.* [16] and of Hamilton Fairley [17] show that it is less toxic than mepacrine and that single weekly doses will suppress the malignant and benign tertian forms of malaria. Paludrine has also been shown by these workers to be a causal prophylactic in the case of malignant tertian malaria, that is, it will destroy the earlier forms of the parasite in man and prevent the disease becoming established. This would be of great use in areas where malignant tertian malaria prevails were it not for the fact that the other forms of malaria are also invariably present though to a lesser extent. Too much optimism should

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not be directed towards this new drug until the results of further field trials are available. The possibility of the malarial parasites becoming drug resistant cannot yet be excluded and also the suppressive effects at the extremes of age have yet to be demonstrated.

(*d*) *The Control of the Human Factor.*—In the Army and especially under field conditions the control of the mosquito and the parasite is not sufficient to prevent malaria unless supported by personal and unit effort [18].

Personal Effort: The success of individual defensive measures against the mosquito and of suppressive treatment depends upon the co-operation of all ranks. The first will fail unless the equipment provided is properly used and the other will break down if there is unwillingness to take the tablets. MacKeith [19], looking at the problem from the psychological aspect, lays down four methods of approach, namely:

(1) Discipline, by the enforcement of a rigid system of definite instructions.
(2) Habit, by the daily observance of malarial instructions and by associating them with other important military duties.
(3) Example given by higher ranks; and
(4) Persuasion in the form of lectures, cinema films, posters, etc.

Unit Effort: In addition to their obligations as individuals, officers and N.C.O.s should realize that the preservation of health and the prevention of disease in the unit is their responsibility [20, 21] and not that of the medical authorities. They must, therefore, be aware of the seriousness of malaria, its manner of spread, and the means of prevention if they are to comply with Regulations. By example and vigilance they must ensure that the men under their command carry out whatever anti-malaria instructions are in force. Advice should be sought from the Regimental Medical Officer and the unit should be guided by him in all health matters and at all times. In mosquito control schemes supervised by the medical authorities, the unit must remember that they have a share in the work (see Appendix I).

The methods by which the medical authorities may obtain the desired co-operation outlined above are those of health education modified to suit the particular malaria problem. The more important of these methods are as follows:

(1) The training of officers and men in malaria prevention by attendance at practical courses in Army Schools of Hygiene.
(2) Lectures by medical officers especially when malaria is prevalent. Interest should be stimulated by describing the local anti-malaria scheme.
(3) Frequent routine inspections of units by medical officers in order to encourage the maintenance of a high standard of anti-malaria discipline.
(4) The use of educational films and leaflets pertaining to malaria.
(5) The use of propaganda. MacKeith, quoted above, draws attention

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to the value of symbolization followed by appeal to the emotions in the use of posters.

(6) Periodic Hygiene Exhibitions to include displays of local malaria interest. These proved most popular among the troops of the Eighth Army in Italy [22].

The Practical Application

A. Medical Responsibilities

Medical Officers in General.—Medical officers who are members of siting boards or reconnaissance parties must always give priority to malaria in affected areas. An outbreak of malaria can be prevented by good site selection. If malaria-free site cannot be found insistance upon the institution of a general anti-mosquito campaign (Appendix I), well in advance of occupation, will do much to prevent the occurrence of the disease [23].

The Regimental Medical Officer.—When an outbreak of malaria occurs the R.M.O. can play a very important part in limiting the spread of the disease and preventing further cases occurring. From his clinical experience and local knowledge, he will be one of the first to suspect the presence of malaria. While recent movements are still fresh in the patients' minds he will be able to ascertain where the infection occurred (when there are several cases of malaria the source of the infection can often be determined fairly accurately without necessarily knowing the species of the parasite responsible) and the personal precautions taken by the victims at the time. The R.M.O. will then be in a position to advise his Commanding Officer to arrange for the place of infection to be avoided if it is outside unit lines. He can arrange for personal measures to be enforced where they have failed. By lectures and talks he can keep the troops aware of the presence of malaria and of the means of prevention. By informing the D.A.D.H. he can bring early notice of the presence of the disease to the attention of the medical authorities.

Medical Officer in Charge of Wards.—Medical officers doing duty in medical wards of hospitals can assist greatly in bringing the disease under control. They can determine accurately the source of infection by the laboratory diagnosis of the type of malaria, by their knowledge of the characteristics of the local parasites, by excluding the possibility of a relapse and from a detailed medical history of the patients. This information must be submitted immediately to the A.D.M.S. (Assistant Director of Medical Services) from whom it will be passed to the D.A.D.H. [24].

Deputy Directors of Hygiene.—In a country where malaria is prevalent the D.A.D.H. is required to know the distribution of malaria throughout his area, the incidence of malaria in the military population, the location and extent of any outbreak of the disease, the effectiveness and state of any existing control measures, and in a seasonal station the approximate date of the onset of the epidemic period and the extent of the disease in the civil population.

This information is required not only to keep the Area Commander and higher formations aware of the malaria situation, but in order that prompt action may be taken to stop an outbreak. It will also enable instructions to be

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issued and control measures to be instituted well in advance of the malaria season. This information can be obtained from the weekly hospital returns, the notifications of infectious diseases submitted by the medical officers making the diagnosis, entomological data, personal observations made during the inspection of units and of anti-malarial control schemes, meteorological reports, and reports and returns relating to previous years. A scheme for enabling the D.A.D.H. to make an appreciation of the malaria situation is given in Appendix II.

B. *Routine Procedure*

From the information given above it is necessary for the D.A.D.H. to determine if the source of the outbreak is within his area or outside. If without, then all that is necessary is to inform the other authorities concerned. If within the area it is necessary to determine whether the source is in civil or military territory. If the former the local authority should be informed and if possible the locality concerned should be put out of bounds to all ranks. On the other hand if the source is in the military zone, the establishment concerned must be visited and a general investigation carried out.

The military importance of the location should be ascertained and the severity of the outbreak determined. Existing anti-malaria measures should be inspected. A brief survey of the locality both inside and outside the military lines should be made. The presence of potential mosquito breeding places and the proximity of native villages should be noted. The possibility of instituting active anti-mosquito measures should be estimated if they are not already in existence.

As a result of the findings made during the above investigation it will usually be possible to tender advice to the military authorities along one of the following lines:

(1) The removal of the unit concerned to a healthier place if the military situation permits.

(2) The remedying of defects observed in the existing anti-malarial scheme.

(3) The establishment as indicated below of anti-malarial measures if not already in existence.

C. *Anti-malarial Measures and Their Indications*

(1) If the outbreak is a small one and the cases are mild, individual defensive measures against the mosquito should be recommended. If possible all living quarters should be screened. If the vector is known and is a domestic species, spraying to produce the immediate killing of adult mosquitoes should be carried out in all living quarters and native houses within flight range.

(2) If at the end of a period equal to the incubation period of local infection, there is no improvement in the malaria situation, then existing defensive measures should be supplemented by a general anti-mosquito campaign as described in Appendix I in so far as local circumstances permit.

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(3) Suppressive treatment is indicated if military man-power is scarce, hospital facilities are wanting, and the risk of a breakdown in the other anti-malarial measures cannot be afforded.

Discussion

The material means, such as equipment, supplies of insecticides, and casual labour will generally be available wherever the Army is serving. Failure of, or a breakdown in, the anti-malarial plan will in most areas be due to the inadequacy of human co-operation, either on the part of those who are to be protected or on account of medical inertia.

The remedy for the former cause has been discussed already. The latter depends on the training of all medical officers, not only at the Army Medical College and the Army School of Hygiene as is done at present, but in their stations overseas when they are in immediate contact with the actual problem. Regimental medical officers must realize that the prompt tracking down of the source of an infection is just as important, as far as the health and the morale of the unit is concerned, as the speedy admission of the patient to hospital. Medical officers in hospitals should realize that their responsibility is not confined to the diagnosis and treatment of the illness. The patient's history should mean more than an account of his symptoms before admission to hospital. It is the important clue which enables the medical administration to pin-point the source of the infection and put into operation the machinery of prevention and control. The D.A.D.H., even in the absence of sickness, must maintain a state of constant watchfulness. By means of his own observations, the various records and other information at his disposal, he should keep a metaphorical finger on the malarial pulse of his area, ready at the slightest alteration in its character to take the appropriate action.

The present Army organization may be quite adequate as a short-term policy, but future needs must be given consideration. One of the functions of the Army in times of peace is to provide an efficient and elastic nucleus capable of expansion and rapid modification so that it may be prepared if the world is ever again plunged into war. That this applies as much to the anti-malarial organization as to the other branches of the medical services was demonstrated in World War II when in India the pre-war anti-malarial schemes and the plans produced during the early years of the war were insufficient to cope with the enormous expansion of the Indian Army and its responsibilities under active operations [25].

Malariology is a highly specialized subject and requires the whole-time study and attention of those concerned with even the smallest outbreak. The peacetime anti-malarial organization of the Army should, therefore, consist of a framework that, though self-contained, will not be independent but will work alongside the existing hygiene organization at every level in the chain of command. In this way it will be possible to produce an anti-malarial plan than can be co-ordinated with the general hygiene policy and so avoid much of the overlapping and many of the errors of the past. With one body concerned with malaria only, it will be possible to provide the time and personnel

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to use to the best advantage the valuable war experience and the recent development in this sphere of medical science, as well as supplying the means necessary to direct and carry out further research into the malarial problem affecting the fighting forces.

Conclusions

(1) An account is given of the methods of malaria control most commonly used in the Army.

(2) A scheme is described whereby these methods may be applied to a particular malaria problem.

(3) The importance of medical co-operation is stressed.

(4) The necessity for an anti-malarial organization is stated.

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Appendix I.—A General Anti-Mosquito Campaign

A general anti-mosquito campaign consists of a special investigation into the habits of the local vector followed by the necessary control measures. Personnel trained in malaria survey and control methods are required and should have skilled supervision. The methods described here are the minimum consistent with satisfactory results.

(*A*) *Special Investigation*

A large-scale map of the area to be protected and the surrounding country for at least a mile beyond is required. The map should include the location of all sleeping and living quarters within the area to be protected (protected zone) (fig. 1). Assuming

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the effective flight range of the mosquito to be a half-mile, the limits of an area a half-mile beyond the boundary of the protected zone should be drawn on the map. This line bounds the limital zone. Similarly an extra-limital zone should be mapped out again a half-mile in depth.

All breeding places within the limital and protected zones should be entered on the map. They should be searched for anopheline larvæ which should be forwarded in labelled specimen tubes to an entomological laboratory for identification. A record of the location of larvæ should be kept.

Places where adult mosquitoes are likely to frequent should be entered on the map as routine collecting stations. These should be selected in the centre of the zone and at intervals around the periphery of the protected, limital and extra-limital zones (fig. 1). The collecting stations should be numbered consecutively and should not be included in any routine adult-spraying programme which may be in force. A daily record should be kept of the number of adult anophelines found in each collecting stations and samples should be forwarded in Barraud's cages [1] to the laboratory for identification and dissection.

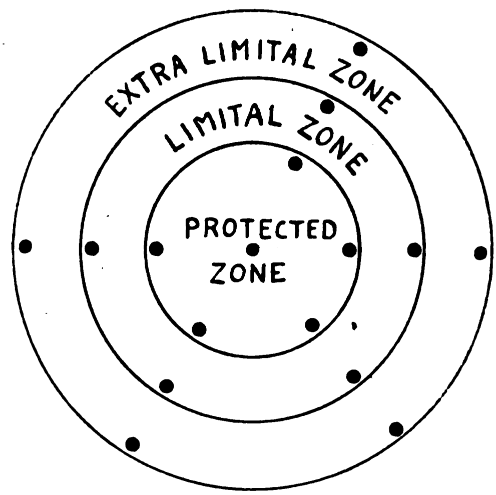

Fig. 1.—Diagram of Survey Scheme. (Adult collecting stations entered as a dot.)

The results of the above investigation should provide information regarding the amount of breeding taking place, and whether the larvæ found are recognized vectors. The adult catches should corroborate these findings. If none of the larvæ were vector species, the search for breeding places will have to be intensified or extended. A possible clue may be provided by the disposition of the collecting stations in which the greatest numbers of adults were caught.

(B) *Mosquito Control*

Offensive control measures against the mosquitoes should first of all be of a temporary nature. If successful results are obtained more permanent measures may be considered.

The whole area within the limital boundary should be divided into five sectors (fig. 2). Each sector should include at least two collecting stations and the boundaries should be made to correspond with features such as roads, streams or railways to facilitate easy recognition by the labour parties.

All the actual breeding places within one sector are treated each day, with the result that the whole area is covered within a week. An adult spraying campaign should

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follow a similar routine but should not include the collecting stations which are retained for the purpose of checking.

In military control schemes it is usual for the limital zone to be the responsibility of the hygiene authorities, the protected area being treated by the unit concerned but under skilled supervision.

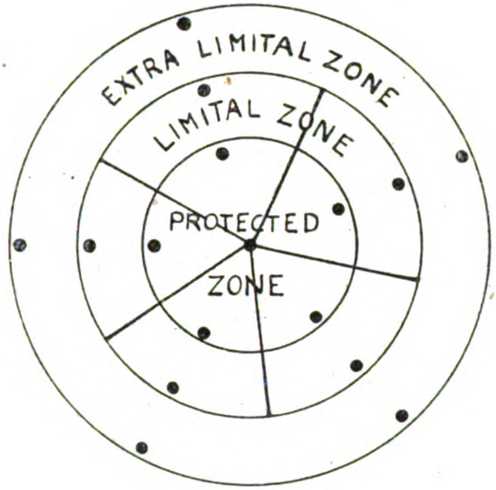

FIG. 2.—Diagram of a control scheme showing the treated area divided into Sectors. (Adult collecting stations entered as a dot.)

Apart from hospital admissions the efficiency of a scheme such as the above can be determined from records of the total daily or weekly catches made in collecting stations. In a successful control, catches made within the protected area should be negligible whereas those made outside should remain high. The extra-limital collecting stations also prevent false credit being given to the effect of the control scheme, when, for example, the total catches commence to fall towards the end of the malaria season.

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APPENDIX II.—THE APPRECIATION OF THE MALARIA SITUATION

A scheme on the following lines may assist the D.A.D.H. in complying with the requirements stated above. The following records should be maintained in his office:

(1) A large-scale map of the area. When the source of an outbreak of malaria is located the place is flagged. Every case of malaria attributed to that source is marked by a pin with a coloured head. This is a useful way of demonstrating the extent and seriousness of malaria in the area.

(2) A chart giving a list of the sources of infection to which outbreaks have been traced. The weekly total of cases attributed to each source should be entered. This enables the effect of anti-malarial measures to be determined.

(3) Graphs or record of accurate statistics, viz. weekly hospital returns, to show the weekly or monthly admissions of malaria to hospital for:
   (i) The whole area.
   (ii) Each station in area.
   (iii) Individual units.

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For (i) and (ii) a rate based on the number of cases per 1,000 of the military population should be worked out. These returns and rates are required to provide material for reports which may have to be submitted.

(4) Entomological data, if available, in the form of the results of weekly adult catches made in mosquito-collecting stations (*see* Appendix I).

(5) Meteorological data:

(*a*) Rainfall: A chart or graph showing the daily or weekly totals for the various stations in the area. This is often a most useful way of forecasting an increase in the malaria incidence. In some countries an increase in the rainfall during the rainy season is followed in four to six weeks by a rise in the number of cases. In the Punjab it is possible to make a preliminary forecast as least three months in advance [1].

(*b*) Temperature (maximum and minimum) and relative humidity should be entered daily on a graph. Horizontal lines drawn across the graph showing the optimum relative humidity and the optimum range of temperature for the prevalent parasite and the particular vector will enable one to determine whether or not transmission is occurring and the date of its onset.

(6) Military and civilian malaria returns and meteorological data from previous years will provide valuable information regarding the trend of malaria in the area.

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SICKNESS AND MORTALITY RATES OF THE ENGLISH ARMY IN THE SIXTEENTH CENTURY

BY

DAVID STEWART

THROUGHOUT the sixteenth century we hear reported again and again the same monotonous melancholy story of disease, epidemics, and death among the soldiers of the English armies. Unfortunately, most of these accounts are purely descriptive and give but few details from which it would be possible to calculate the actual incidence of sickness among the troops. Even when commanders condescend to mention figures, these are obviously only guesses, and cannot be relied upon as material to form estimates of the proportion of the men who were sick or unfit for duty.

If this was the only evidence, all hope would have to be abandoned of our ever being able to investigate this matter. Fortunately, however, a number of muster returns have been preserved, and from these it is possible to draw up tables to show the sickness rate of, at least, some portions of the Elizabethan armies.

The question immediately arises, how much reliance can be placed upon these returns? To decide this point it will be necessary to consider the conditions under which the musters were made and the influence that would tend to make them unreliable. Right at the start it must be acknowledged that the Army of that period, like most of the other departments of the public service, was riddled with corruption. Company commanders did not hesitate to line their own pockets by cheating the Crown and robbing their men. In any financial matters concerning their companies they could not be trusted in the slightest degree. The purpose of the musters was to check the irregularities of the captains, and to ensure that the State paid only for the actual number of fit men in a company, and not for the number that the company commander claimed belonged to it. The money disbursed as a result of these musters included not only the pay of the men but also all other monies due to them for the financial period in question. These were paid in a lump sum to the company commander, so that he could settle the bills of the company and pay the men the balances due to them. It was the aim of unscrupulous captains to keep the strength of their companies as low as possible for the greater part of the year, and only to bring them up to strength on the days of the musters. This they did, either by borrowing men from other companies, or by hiring civilians by the day, to fill the vacant places until the inspection was over.

On the other hand, it was the duty of the muster-masters to see that these frauds were not allowed to pass undetected, and if they had done their work

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Table I.—Troops at Lough Foyle. (Foot only, excluding officers)

1	2	3	4	5	6	7	8	9	10	11	12
Date	*Present and fit*	*Present and sick*	*Total present*	*Sick per 100 of total present*	*Deficient*	*Non-effectives col. 3 + col. 6*	*Establishment*	*Non-effectives per 100 in establishment*	*In List*	*Reference to C.S.P.I.*	*Remarks*
Feb. 16, 1601 ..	1,083	473	1,556	30·40	(1,204)	(1,677)	(2,760)	(60·76)	3,000	1600–1 p. 191	Numbers deficient calculated. Not given in the returns.
Apr. 1, 1601 ..	1,614	438	2,052	21·37	(708)	(1,164)	(2,760)	(41·53)	3,000	1600–1 p. 263	
July 27, 1601 ..	2,141	342	2,483	13·77	277	619	2,760	22·42	3,000	1601–3 p. 60	A return on p. 24 gives fit 2,120, sick 313
Aug. 18, 1601 ..	1,939	380	2,319	16·39	443	823	2,762	29·80	3,000	1601–3 p. 43	
Sept. 3, 1601 ..	1,539	507	2,046	24·78	714	1,221	2,760	44·24	3,000	1601–3 p. 53	
Sept. 24, 1601 ..	1,325	631	1,956	32·26	805	1,436	2,761	52·06	3,000	1601–3 p. 100	Donegal returns are those of the previous month
Oct. 28, 1601 ..	1,343	629	1,972	31·89	809	1,438	2,781	51·71	3,000	1601–3 pp. 178–80	
Nov. 25, 1601 ..	1,685	503	2,188	22·99	572	1,075	2,760	38·96	3,000	1601–3 p. 189	
Dec. 24, 1601 ..	1,559	394	1,953	20·17	(797)	(1,191)	(2,750)	43·31	3,000	1601–3 p. 236	197 entered as unable to travel added to col. 2. pd. Deputy allowed 10 more dead pays
Aug. 19, 1602 ..	1,160	327	1,487	21·99	353	680	1,840	36·96	2,000	1601–3 p. 472	
Jan. 14, 1603 ..	1,044	217	1,261	17·21	119	336	1,380	24·34	1,500	1601–3 p. 555	

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conscientiously all would have been well. Unfortunately many of these officials were just as corrupt as the captains; they were open to bribery and would shut their eyes to any irregularity, provided that they were sufficiently compensated for their pains. If, exceptionally, there should happen to be an honest muster-master, he was given such a miserable time, not only by the captains, but also by the senior commanders who profited as well by these irregularities, that he was only too glad, either to resign, or to take the line of least resistance and overlook the gross peculations of the military officers.

A short, but very clear, account of the difficulties of conducting the musters will be found in Cruickshank's "Elizabeth's Army"; and anyone wishing for further information on this and other aspects of military life of that era should consult this most interesting little volume.

The higher authorities knew all about the tricks of company commanders at the musters, and did what they could to circumvent them, generally with but little success. Any muster return of this period must therefore be treated with the utmost suspicion, and it must never be forgotten that they tend to minimize the numbers that were sick or absent.

The first set of figures to be examined comes from the force in the Lough Foyle district during the years 1601–3. It is probable that these are fairly accurate as the Government by this time was keeping a very watchful eye upon the musters, and was making every effort to see that they were reasonably correct. These muster reports are to be found in the Calendar of State Papers for Ireland, and from the figures therein contained Table I has been constructed.

Column I gives the date of the muster. Columns 2 and 3 were taken directly from the returns. This also applies to column 6, except in three instances, indicated by the figures being placed within brackets. In these three returns the numbers deficient were omitted, and have been calculated on the assumption that the establishment of the Army remained at 2,760. The remaining columns have been calculated from these figures, except those in column 8, which must now be discussed. The numbers under the heading "In List" during the greater part of the period stood at 3,000. It might be thought that this corresponded to the modern term "Authorized Establishment." But the figures "In List" include a number of "dead pays," or non-existent men, and these must be deducted from the total before the true establishment of the force can be ascertained. These dead pays varied from time to time, but in the Lough Foyle force 6 were allowed per company of 100 men. In each company 1 cannoner and 1 chaplain were also allowed, but these posts were not filled. From this it will be seen that 8 per cent of the number "In List" were fictitious, and must be deducted to obtain the true establishment. As the list strength was 3,000, 8 per cent of this is 240, and so the establishment of the force was 2,760. It is to be noted that, in December 1601, the Lord Deputy appears to have allowed an extra 10 dead pays to this force, which reduces the establishment to 2,750 for that month. By August 1602 the List strength had been reduced to 2,000 with an establishment of 1,840; while the corresponding figures for January 1603 were 1,500 and 1,380.

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These facts enable us to a certain extent to check the accuracy of the figures in the returns. If they were correct, the figures in columns 2, 3, and 6, when added together, would come to exactly 2,760 during the year 1601. Actually on only three occasions out of six, when the returns give the full figures, does this occur. On the other three occasions the figures are 2,761, 2,762, and 2,781. This indicates that returns were not then made with the meticulous care that is taken at the present day. In the two returns for 1602 and 1603, the figures correspond with those in the establishments.

The last column contains the references to the pages of the calendar from which the information has been obtained.

Before discussing the figures embodied in Table I it will be instructive to glance at the previous history of this force. It was a newly raised body of troops that landed in Northern Ireland about March 1600 with a strength of 4,000 foot "In List," or an actual establishment of 3,680. There was also a certain number of cavalry. In May of that year the commander of the force reported that the troops were healthy (C.S.P.I. 1600, p. 196). After this, however, they suffered severely from sickness; and their commander, on August 27, declared that not more than 800 of them were fit for duty (*ibid.*, p. 380). In September the strength of the force was reduced by the sending of nominally 1,000 foot off to Ballyshannon; this brought the numbers "In List" down to 3,000, which is the figure shown in Table I. The troops remained very sickly throughout the winter, and on February 16—the first entry in the table—the number of fit men was only 1,083. At this time the percentage of sick men was 30·40, but, later, there was a steady improvement until the end of August when, as was usual in Ireland, the sickness and ineffective rates once more began to rise. By the end of September half the force was again ineffective, and one-third of the troops present in the garrison were sick. It would appear also, from the two isolated returns for 1602 and 1603, that things did not improve very much in the subsequent years. This is of importance as at that time, and for many years later, it was believed that troops became "salted" after the first year of their service, and were afterwards less susceptible to disease.

These soldiers in Northern Ireland were living in conditions somewhat analogous to those found on the North-West Frontier of India in recent days, at times when the frontier tribes were restless and giving trouble. They were always more or less on active service, and life in that part of Ulster was then rough and primitive. The result, as we shall see later, was that the sickness approximated more closely to those for troops of active service than for soldiers who were located in more comfortable garrisons. If this is kept in mind, and if it be remembered what could happen to troops at a much later period, the sickness rate will not appear to be quite so horrible. What was the position during the Peninsular War, when the Medical Services were considered to be extremely efficient and when medical officers were given the greatest credit for the way in which they dealt with the sick?

Information on this point can be obtained from an important paper by T. R. Edmonds, in the *Lancet* of 1887–8, vol. ii, pp. 143–8. This author made

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a very careful study of the monthly returns at the Adjutant-General's office at the Horse Guards, and found, among other things, that the average number of the rank and file constantly sick during that campaign amounted to 22½ per cent of the force. During unhealthy seasons it was much worse as can be seen from the figures published in the volumes of Wellington's Despatches. As an example the figures for January 1813, taken from volume vii, pp. 748–9, are given in Table II.

TABLE II.—BRITISH ARMY IN THE PENINSULA, JANUARY 1813.
(Cavalry and Infantry only, excluding officers)

1 Date		2 *Present and fit*	3 *Sick*	4 *Total*	5 *Sick per* 100 *of total present*
January 1	..	33,542	17,698	51,240	34·54
January 8	..	33,976	17,384	51,360	33·84
January 15	..	33,858	17,163	51,021	33·64
January 31	..	33,169	16,456	49,625	33·16

It will be observed that during this month the sickness rate was well over 30 per cent of the strength of the troops, and was at least as heavy as the rate in Northern Ireland at the worst periods.

Such was the state of affairs in the early nineteenth century during a well-managed campaign. Let us see what could happen when the staff work of a force was really bad. The answer to this question can be obtained from the Crimean War.

TABLE III.—BRITISH ARMY IN THE CRIMEA
OCTOBER 1854 – APRIL 1855.

1 Date		2 *Present and fit*	3 *Sick*	4 *Total*	5 *Sick per* 100 *of total present*
October 1854	..	14,039	4,508	18,547	24·2
November 1854	..	15,303	6,744	22,047	30·5
December 1854	..	17,434	8,342	25,776	32·3
January 1855	..	15,508	11,070	26,578	41·6
February 1855	..	13,617	13,428	27,045	49·6
March 1855	..	12,231	12,772	25,003	51·0
April 1855	..	13,065	9,982	23,047	43·3

All figures, including column 5, by Miss Nightingale.

This table is taken from Florence Nightingale's book, "Health and Hospital Administration of the British Army," London, 1858. The figures are based on the returns of the Adjutant-General and Medical branches of the Army. In March 1855 more than half the force was incapacitated from sickness. The figures show that the condition of the soldier was a disgrace and a sad reflection on the abilities of the military authorities of the nineteenth century and would have been scandalous at any period. But these figures, at least, do put those for Lough Foyle in their proper light, in fact, by comparison, the garrison appears almost to be healthy.

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Probably the only conclusion to be drawn is, that until medical science had become sufficiently advanced to discover the causes of the diseases that affect armies in the field, and had found the means of checking their spread, it was impossible, whatever care was taken, to prevent a very high rate of sickness among soldiers on active service.

Nothing has been said about the non-efficiency rates of the troops at Lough Foyle. These included not only the number who were sick or who had died, but also those who were absent with or without leave, or who had deserted. Their value, therefore, as an indication of the healthiness or otherwise of the troops, will depend upon the number of men who were absent for any other reason than sickness or death. In most campaigns of the period, it was considered that, at the end of six months, the average body of troops would have diminished in strength by at least 50 per cent, and that the larger portion of this drop would be due to desertion. The non-effective ratios are often more an indication of the state of the discipline of the troops, than of the state of their health.

The question arises, what was the cause of the deficiencies at Lough Foyle: were they due to death and invaliding, or were they merely caused by desertion and absence? Some information on this point, and upon the accuracy of the returns as a whole, can be got from some reports from Anthony Reynolds to Sir Robert Cecil, which are contained in the Irish Calendar. Reynolds was the commissary for musters at Lough Foyle; it would appear that he was comparatively honest, and, on this account, was for a time placed under arrest by the commander of the forces.

The first report deals with the differences between the figures in the returns of July 27 and those of August 18. He was responsible for the latter return. He draws attention to the increase in the numbers deficient during that short period of twenty-one days. These, he says, cannot be accounted for by the number of men who had been killed since the last muster, because these amounted to six in all. The real reason was that the first return was inaccurate. He, himself, had found companies in which as many as twenty men were brought forward at the musters who were not soldiers, but were borrowed to deceive the Queen (C.S.P.I., 1601–3, p. 59). This may explain why the proportions of sick and non-efficients were so low at the July muster. But it will be noted that at the muster made by Reynolds himself these proportions are still the second lowest in the series. Viewing the figures as a whole, it appears that after July there was a steady rise in the rate of sickness, and it is possible that these July figures are not as inaccurate as Reynolds makes them out to be.

During the month of September there was a further rise in the figures for sick and non-effectives. Reynolds accounts for these as follows. On September 17, 50 men of Captain Atkinson's company were killed by the enemy; 50 sick men were evacuated to England, and at least 200 died (*ibid.*, p. 102). At first sight this seems to prove too much, as there was only a diminution of the fit men of just over 200 between September 3 and 24; but there are one or two more days of September to be added, and it is pos-

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sible that Reynolds did not exclude the last few days of August. Be all this as it may, it at least does suggest that, at Lough Foyle at any rate, the deficiencies were due largely to sickness and death among the troops.

The last report from Reynolds was dated December 14 (*ibid.*, pp. 214–5), after he had been released from arrest, and when he was feeling a little sore about the treatment that he had received. He had not been allowed to carry out the duties of his office as Commissary for Musters, and the Governor had appointed two of his own nominees for this purpose. Reynolds is naturally critical of their work, but it must have done reasonably well. The table shows that the number of deficients calculated from the figures in the muster returns comes to 979, while Reynolds' guess was 700.

These various criticisms of Reynolds, self-confessed hostile witness, come to very little, and they tend to increase our confidence in the musters, which we can, therefore, assume to be reasonably accurate.

The next series of figures are from troops on garrison duty, situated in parts of the world that were then more civilized and comfortable than Lough Foyle. These are given in Table IV, which summarizes information that is available from three different garrisons; Havre, Berwick, and Zutphen. They are all taken from The Calendar of State Papers Foreign.

Havre had been occupied by an English garrison in the autumn of 1562, and the returns given here are for March, April, and June of the following year. It will be seen from the percentage of those sick, that we are dealing with a very different state of affairs from that found at Lough Foyle.

But in the beginning of June plague broke out in the garrison, and the first signs of its presence are indicated by the rise in the sickness rate in the return of June 12. At the same time the town was besieged by the French, and the troops suffered both a strenuous siege and an extremely severe epidemic of plague. The garrison put up as gallant a defence as was ever made by English troops; but by the end of July they were finally defeated, not by the French, but by the devastating mortality of the epidemic. However, from the figures in Table IV it is clear that, up to the time of the outbreak of plague, the health of the troops at Havre had been good.

For April 30 two sets of figures are available, and both are shown in the table; the first is for the foot companies, and the second one is for the total garrison. Two lots of figures are also available for June 12. It is quite obvious that the figure 3,839 refers to the foot only and the other 7,401 is for the whole garrison. But it will be noticed that the numbers given for the sick are the same in both returns. It is clear that as far as it concerns the infantry the numbers must be a good deal less than this, and that therefore the incidence of sickness must have been less than 10·32 per cent. In regard to the figure of 7,401 for the total garrison, this number is definitely an exaggeration, for, at the best, the strength of the garrison should have been only 7,000, and it never reached that size. One wonders whether someone has not made a slip of the pen and that the figure should be 5,401. Be this as it may, in this case the calculated sickness rate must be too low at 5·64. What the actual rate was

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TABLE IV.—TROOPS IN GARRISON.

1	2	3	4	5	6	7	8	9	10	11
Date	*Present and fit*	*Present and sick*	*Total present*	*Sick per 100 of total present*	*Deficient*	*Non-effective col. 3 + col. 6*	*Establish-ment*	*Non-effective per 100 in establish-ment*	*Reference*	*Remarks*
					HAVRE					
March 2, 1563 ..	5,348	119	5,467	2·18	—	—	—	—	p. 404, 1563	
April 30, 1563 ..	3,280	71	3,351	2·12	195	266	3,546	7·50	p. 307, 1563	Foot companies
	5,635	186	5,821	3·20					p. 404, 1563	
June 12, 1563 ..	3,839	442	4,281	10·32	—	—	—	—	p. 397, 1563	Plague broke out early in
	7,401	442	7,843	5·64					p. 404, 1563	June 1563
					BERWICK					
July 16, 1563 ..	194	3	197	1·52	10	13	207	6·28	p. 454, 1563	Old Crew
July 16, 1563 ..	617	11	628	1·75	23	34	651	5·22	p. 454, 1563	New Crew
July 16, 1563 ..	811	14	825	1·70	32	46	857	5·37	p. 454, 1563	Total garrison
Oct. 4, 1563 ..	1,419	4	1,433	0·97	150	164	1,588	10·33	No.1264,1563	Total garrison
Jan. 12, 1564 ..	193	3	196	1·53	87	90	283	31·80	p. 11, 1563–4	Old Crew
Jan. 12, 1564 ..	1,085	—	—	—	—	75	1,160	6·47	p. 11, 1563–4	New Crew
Jan. 12, 1564 ..	1,278	—	—	—	—	165	1,443	11·44	p. 11, 1563–4	Total garrison
					ZUTPHEN					
Sept. 26, 1586 ..	6,172	524	6,696	7·83	—	—	—	—	p. 167, 1586-7	English. The return gives total present as 6,706
Sept. 26, 1586 ..	898	47	945	4·97	—	—	—	—	p. 167,1586–7	Scots. The return gives total present as 947
Sept. 26, 1586 ..	4,797	105	4,902	2·14	—	—	—	—	p. 167, 1586-7	Dutch. The return has same figure as the table for total present
Sept. 26, 1586 ..	2,125	110	2,235	4·92	—	—	—	—	p. 167, 1586-7	Cavalry. The return has same figure as the table for total present

we have not sufficient information to determine, but it must lie somewhere between 5·64 and 10·32, and if we make it about 8 per cent we shall probably not be far out in our reckoning.

There is one figure recorded of the number of deficiencies; from this it will be seen that, at least on one occasion, the non-effective rate was much better than that for Lough Foyle, and is very much like that for Berwick, which will be discussed later. The figure of 195 deficients is made up as follows: Discharged 110, Dead 36, On Leave 31, Deserters 18. The discharged are presumably invalids, and, therefore as at Lough Foyle, the deficiency rate once more gives some indication as to the health of the garrison.

At Berwick, the health of the garrison in the years 1563 and 1564 was good. From the figures at our disposal, it would appear that the rate of sickness varied between 0·97 and 1·75 per cent. Indeed it is so good, that one wonders whether these are not further examples of false musters. In this garrison some figures for the non-effectives have been preserved; and it is possible to make a comparison between these and the similar figures for Lough Foyle, already put forward in Table I. It will be seen that the comparison is greatly in favour of Berwick. On only one occasion do the numbers of non-effectives in that garrison approach the ratio at Lough Foyle, and then only in a portion of the garrison. This was in January 1564, when the older troops of Berwick had a non-efficiency rate of 31·80; at this time the figure for the newer troops was only 6·47. But it is probable that a similar state of affairs existed in the previous October. If the figures for that month be examined, although they do not distinguish between the new and the old crews, they suggest that, on this occasion also, the non-effective rate among the older troops was higher than among the newer ones.

When the figures for Lough Foyle were discussed, it was shown that the non-effectives were probably due mainly to invalids and death vacancies. At Berwick the state of affairs was very different. On July 16, the deficiencies among the old crew were made up of 9 absentees and 1 man who had never actually reported for duty. At the same time 21 of the new crew were absent, and 2 had failed to report. In the return of October 4, 132 men were absent and there were 19 death vacancies. On January 12, 1564, the deficiencies in the old crew were 77 absentees and 10 dead. There were 10 death vacancies among the new crew at this time. It is therefore clear that, at Berwick, the deficiency figures are of little value for estimating the health of the garrison; indeed their only value would be as a basis for assessing the discipline of the troops.

Throughout the reign of Queen Elizabeth absenteeism and desertion were rife. For this reason figures of deficiencies must be used with the utmost caution when investigating the incidence of sickness, or the rate of mortality among any given body of troops. Unfortunately, these are often the only ones available; commanders simply report the number of men that they are short of and, for their own credit, suggest that these deficiencies were due to sickness for which they could not be considered responsible, rather than to a lack of discipline among the troops for which they could have been censured. But

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such statements should never be accepted at their face value, and it will generally be found that the greater portion of the deficiencies in an army were due to absentees rather than to sick men.

To return to the Berwick garrison for a moment; there can be little doubt that life for the soldier in that town was much pleasanter and easier than it was for his comrades at Lough Foyle. Pelham was undoubtedly correct when he wrote to the Privy Council saying:—

> "Touching the comparison between the soldiers of Berwick and the soldiers of Ireland, alleging him of Berwick to serve in great toil. If I have any judgment, all the soldiers of Christendom must give place to the soldiers of Ireland; and so much difference for ease; if Captain Cace, Pickeman, and Walker may be judges, as is between an alderman of London and a Berwick soldier. But these Irish soldiers live under unhappy stars; so I leave them, for the climate will yield no better" (Calendar Carew Papers, 1578-88, p. 219).

It is to be noted that when Pelham refers to Irish soldiers, he means English soldiers serving in Ireland.

The last group of figures in Table IV concerns the soldiers at Zutphen, and is of particular interest because the members of that garrison consisted of English, Scottish, and Dutch troops. As was to be expected, the Dutch were much healthier than the English or the Scots. They were serving in their own country, and presumably had established a certain amount of immunity to the common diseases in the Low Countries.

Among the English troops the sickness rate was high, and it was appreciably greater than that for the Scots, which certainly was not low. However, when we consider the country, and the time of the year, it is probable that the health of these troops was not unsatisfactory. The Low Countries in the autumn have always been notorious for their effect upon the health of British troops. The lower rate of sickness among the Scots bears out the then generally accepted opinion, that the Scots were more resistant to disease and hardship than the English. This was put down to the lower standard of living to which they were accustomed in their native land, compared to the conditions to be found in England. The Irish were thought to be much healthier than either, because it was considered that they had no standard of living at all in their native land.

As at Lough Foyle, there are in this return one or two errors in simple arithmetic, which have been noted in Table IV. According to the return, the total present of the English troops is 6,706, but if the numbers present and sick are added together the number present comes to 6,596, which is 7 less than that given in the return. In the same way with the Scots, the total in the return is 947, but if, again, the present and the sick are added together, the total is two less, namely 945. The totals for the cavalry and the Dutch correspond. Such errors as this may tend to make us suspicious of the accuracy of the whole return, but there is this to be said for the authorities of the time, addition was not quite as easy or as well understood as it is at the present day. The arabic system of numbers was not so familiar to them as it is to us; people were more familiar with the Roman system—the great Lord Burleigh was in the habit of changing Arabic numerals into Roman ones, in the documents that he received—and this system makes addition a major operation of war. Fortunately, in the present

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case the errors are so slight that it makes little difference to the calculated rate of the incidence of sickness.

Figures about the plague epidemic at Havre, already referred to, are fairly extensive, and it is possible to make an approximate estimate of the devastation caused to that garrison by this terrible scourge.

The outbreak began in the early days of June 1563. By the 9th of the month, deaths were occurring at the rate of 20 to 30 a day (C.S.P.F., 1563, p. 396). On the 21st (*ibid.*, p. 425) the death-rate was 200 a week, so it had remained pretty constant since the 9th of the month. On the 27th (*ibid.*, p. 430) it was reported that the rate had trebled, and that there were now 60 deaths daily, and it remained steady at this figure until July 2 (*ibid.*, p. 439). By the 11th it had risen to a hundred, and there were not only 1,500 men fit for duty in the garrison (*ibid.*, p. 448). A week later the mortality rate had probably increased slightly, for it was reported that there were now between 100 and 120 deaths daily. Although about 1,000 reinforcements had arrived, there were only 2,000 men fit for duty. Some more soldiers arrived a little later; but the English Government began to realize that the situation was hopeless and withheld further reinforcements, with the result that the commander of the garrison was compelled to surrender on July 29.

From the information given above, it is possible to gain some idea of the numbers of deaths among the garrison during this siege. The mortality rate remained steady at about 28 deaths a day or 200 a week from June 9 to 21, the deaths during this period of thirteen days would therefore be about 360. From June 21 to July 2, the mortality was 60 a day; so that in these eleven days 660 died. By July 11 the death-rate rose to 100 a day; taking 80 as an average between 60 at the beginning and 100 at the end of this nine-day period, we get 720 deaths. From now to the 18th of the month, when our information stops, the mortality was at least 100 a day, which makes another 900 deaths. From these calculations it will be seen that between June 9 and July 18, 2,600 people died of plague out of a garrison of about 5,500 men plus some 2,000 reinforcements. This is a dreadful sacrifice of human life, but was it any worse than what happened in military epidemics at much later periods in our history?

Let us now consider a campaign in which the English were the besiegers and not the besieged. In May 1591, a force under Sir John Norreys was despatched to Paimpol in Brittany, and from this force 600 men were detached to secure the port of Dieppe in preparation for the landing of an army under the command of the Earl of Essex. That nobleman ultimately arrived in August with 3,600 men, which brought the total in this area up to 4,200. If these are "In List" figures the establishment must have been about 3,780. These troops remained at Dieppe until the start of the siege of Rouen in October of that year, in which operation they took part (Black, pp. 360–1).

On October 13 the English had 2,400 in the field, but over and above this there were a large number of sick (Coningsby, p. 29). A review of the English troops was held at Rouen on October 25, when there were 2,000 on parade, and there were 300 sick (*ibid.*, p. 30). On the 27th, 400 sick were embarked at Rouen for England from this force (*ibid.*, p. 31). Further details of the evacuation of

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sick from Dieppe are given by Killigrew (Salisbury, iv, p. 155) who states that, up to the time of the start of the siege, 700 sick men had been evacuated from Dieppe. When the troops marched off to Rouen another 800 were sent off; and on October 30 200 more departed for England: altogether, by the end of October, about 1,700 sick had been evacuated from Dieppe. This does not take into account the 400 men mentioned by Coningsby, who were sent from Rouen direct, which brings the total up to 2,100.

These figures have been given in detail in order that the reader can judge for himself how far we are entitled to make deductions from them. In the first place it will be noticed that they are all-round numbers, therefore probably only approximately correct, and possibly exaggerated. Secondly it is a question whether the sick evacuated directly from Rouen should not be included in the Dieppe figures. It appears from the evidence that this is unlikely, but the possibility must not be forgotten. Thirdly as already pointed out, there is some doubt as to the actual strength of the force, whether the figures given are list figures or the true establishment. The former is the more likely, as this was the usual way of reckoning at this period. Fourthly it is known that Killigrew had great difficulty in preventing fit men from slipping off home with the sick. and it is also uncertain whether all those sick who were evacuated were really seriously ill, and did not exaggerate their complaints as an excuse for getting away from active service.

Taking all these points into consideration, the minimum number of sick who were evacuated was 1,700 and the maximum 2,100, from a force either 3,780 or 4,200 strong. The minimum ratio therefore of sick evacuated to the strength of the force was therefore 40·48 per cent. and the maximum ratio 55·55 per cent. These figures take no account of any sick remaining with the Army or of those who died.

This is an interesting illustration of the way in which armies evaporated on active service during the sixteenth century. It also tends to confirm the opinion. then generally held, that an army in the field lost half its strength in six months. But, as mentioned above, it must not be assumed that all these men were really sick, there is not the slightest doubt that many fit men slipped through Killigrew's fingers, and that the disappearance of half the force was not by any means due entirely to sickness. That this view is correct, is confirmed by a letter from the Privy Council to the commander at Dieppe on May 21 of the following year. In this letter they mention that at the time of the death of Sir Edmond York (date not given), the strength of the force had fallen to 1,500, and that the deterioration was still going on. They therefore ordered Williams to reorganize his command into "eight companies, more or less, at the rate of a minimum of one hundred men to a company." At the same time they instructed him to tighten up the discipline of his soldiers, as a large number of fit men were returning to England with the sick (A.P.C., 1591–2, pp. 478–9). This statement shows that, in about a year, the strength of this force had fallen from about 4,000 to somewhere under 1,000; and that desertion as much as sickness was the cause of its diminution in the size of the force.

Much the same sort of fall in strength went on in other forces. At Antwerp

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in September 1578, the English troops, which should have numbered 3,400, were only 1,500 strong (C.S.P.F., 1578–9, p. 227). In Brittany in January 1593, out of a nominal strength of 3,000, only 1,100 remained (C.S.P.D., 1594–5, p. 307). 3,500 troops were sent to Ireland in 1596, but by July of that year there were not 1,000 of them left. The explanation given, in this case, was that they were "either dead, runaway, or converted into Irish" (C.S.P.I., 1596–7, p. 21).

Yet there were exceptional cases in which no catastrophic fall in the strength of the troops occurred. An English force of about 2,000 men lay in St. Valery throughout the winter of 1596–7 doing nothing. They considered their quarters miserable ones; but when William Lylle took a muster of them in February 1597, he found that they were only 57 under strength and had no more than 300 sick (Salisbury, vii, p. 70).

On two occasions, at least, Carew in Munster, with little cause, complained about the strength of his command. The first was on May 2, 1600, when with a list strength of 3,000 and an actual establishment of 2,700, he had 2,400 fit men and 300 non-effective from all causes (C.S.P.I., p. 1600, p. 142). This gives a low non-efficiency rate of 11·11, but Carew was dissatisfied. On August 11, 1602, he reported: "I am nominally 2,400 foot, but sick, etc. deducted, have not above 2,000 men" (C.S.P.I., 1601–3, p. 468). As is so often the case, it is not clear whether the strength in this report is list strength or actual establishment. If it is the former the non-efficiency rate was 7·21; if the latter, the rate was 16·66. Either would testify to the good health and discipline of Carew's men.

In conclusion, and to sum up, such muster rolls and other information which have been preserved, although probably by no means accurate in every respect, do tend to show that the health of the troops in the reign of Queen Elizabeth was quite as good as that of their successors during the next two and a half centuries; and that little improvement could be expected, or was obtained, until medical science had advanced sufficiently to protect the individual soldier from the most frequently occurring diseases of military life.

KEY TO REFERENCES.

A.P.C.	Acts of the Privy Council.
Black	J. B. Black. "The Reign of Queen Elizabeth."
C.S.P.D.	Calendar of State Papers. Domestic.
C.S.P.F.	Calendar of State Papers. Foreign.
C.S.P.I.	Calendar of State Papers. Ireland.
Coningsby	Sir Thomas Coningsby "Journal of the Siege of Rouen." Camden Miscellany I.
Salisbury	Salisbury Papers. Historical Manuscripts Commission.

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THE PERIODIC DYSPEPSIA SYNDROME

BY

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We are all familiar with the syndrome of periodic dyspepsia which so frequently commences in the middle to late teens, but which may occur for the first time at any age later on. The main symptomatology is that of pain, perhaps just discomfort, which invariably has some definite time relationship to meals and which is usually relieved by alkalies—sometimes by change of posture, pressure, or by the local application of heat—but which may be relieved or aggravated by food. The pain, or discomfort, may or may not be accompanied by varying degrees of nausea with or without vomiting. Associated symptoms may be heartburn and/or waterbrush. Gastric flatulence is not infrequently an associated symptom.

The commonest site of the pain, or discomfort, is in the epigastrium, usually high up in the mid-line or just to the right or left of the mid-line. The pain is variously described as a "feeling of discomfort," "a gnawing pain," "a dull ache," "a sharp pain," etc.

The pain may radiate to the right or to the left or it may bore through to the back between the shoulder-blades. Sometimes pain occurs low down in the mid-line just above the umbilicus.

Nocturnal pain, awaking the patient from his sleep is a frequent and important symptom. In patients with duodenal ulcer there is a high night secretion of acid.

Periods of freedom from symptoms may last for days, weeks, months or even years and have an undoubted relationship to the presence, absence or exacerbation of mental stress or emotional tension.

Barium meal, fractional test meal and examination of the stools for occult blood, after due preparation, may reveal nothing abnormal. Some cases just show varying degrees of hyperchlorhydria with a hypermotile, hypertonic and rapidly emptying stomach. Others show, in addition, appearances described by the Radiologist as "pylorospasm" or "duodenitis." Some of these cases may show occult blood in the stools. Luckily for the patients, as regards proper treatment, in a number of cases an ulcer is demonstrated on opaque meal examination.

The abnormal psychogenic constitution of the patient who suffers from periodic dyspepsia syndrome is always apparent to the experienced observer and it merely varies in degree in the different cases.

This syndrome is believed to be a psychosomatic manifestation and may exhibit signs of an organic nature. In this connexion the following extract from

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a copy of the *Journal of the American Medical Association* of a few years ago is of interest:—

"A patient with a large gastric fistula whose mucosa is readily accessible to view has been studied with regard to the possible genesis and persistence of tissue damage. It was found that:

(1) Acid in small amounts was continuously elaborated in the subject under basal conditions.

(2) Spontaneous transitory phases of accelerated secretion of acid occurred from time to time. These were accompanied by blushing of the mucous membrane and vigorous contraction of the stomach wall.

(3) Emotions such as fear and sadness, which involved a feeling of withdrawal, were accompanied by pallor of the gastric mucosa and by inhibition of acid secretion and contractions. This complex was encountered infrequently in our subject.

(4) Emotional conflict involving anxiety, hostility and resentment was accompanied by accelerated acid secretion, hypermotility, hyperæmia and engorgement of the gastric mucosa resembling "Hypertrophic gastritis." This series of events was much more commonly observed in our subject. It was associated with gastric-intestinal complaint of the nature of heartburn and abdominal pain.

(5) Intense sustained anxiety, hostility and resentment were found to be accompanied by severe and prolonged engorgement, hypermotility and hyper-secretion in the stomach. In this state mucosal erosions and hæmorrhages were readily induced by even the most trifling traumas, and frequently bleeding points appeared spontaneously as a result of vigorous contractions of the stomach wall.

(6) Contact of acid gastric juice with such a small eroded surface in the mucous membrane resulted in accelerated secretion of acid and further engorgement of the whole mucosa. Prolonged exposure of such a lesion to acid gastric juice resulted in the formation of a chronic ulcer.

(7) The lining of the stomach was found to be protected from its secretion by an efficient insulating layer of mucus, enabling most of the small erosions to heal promptly within a few hours. Lack of such a protective mechanism in the duodenal cap may explain the higher incidence of chronic ulceration in this region.

(8) It appears likely, then, that the chain of events that begins with anxiety and conflict and their associated overactivity in the stomach and ends with hæmorrhage of perforation is that which is involved in the natural history of peptic ulcer in human beings." (Wolf and Wolff).

The early cases of the periodic dyspepsia syndrome which consist of symptoms but no signs (Ba meal, fractional test meal and stools all normal) have very frequently the great misfortune to be diagnosed as "functional dyspepsia." Such also is the frequent fate of other cases where the symptoms of the periodic dyspepsia syndrome are well marked and where, although opaque meal and stool examinations are negative, the patients have varying degrees of hyperchlorhydria. Such individuals who are "radiologically negative" are diagnosed as either "dyspepsia," "hyperchlorhydria" or "functional dyspepsia." Often last term is used almost as a stigma by some. A number of medical men use it in such a fashion as to imply that the patient is really a malingerer. Some, indeed, use instead the word "neurotic" in the manner so characteristic of one type of physician whose actual knowledge of psychology and psychiatry is negligible.

I have heard distinguished physicians stating quite definitely that we should be able to recognize the patients with so-called "functional dyspepsia" on

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first interviewing them and that on no account should they ever be admitted to hospital as a full investigation is not only useless but also dangerous as it would fix their minds on their alimentary tract. Furthermore they have advised that should such cases ever be admitted to hospital in error (!) they should be discharged within a week. This is a fallacy.' Such an attitude is hopelessly wrong, dangerous and cruel. It shows a complete lack of appreciation of psychosomatic medicine.

Cases of the syndrome having the good fortune to exhibit evidence of "duodenitis" or "pylorospasm" are usually diagnosed as having organic disease and so receive reasonable treatment for their complaint. However, what a difference there is in the attitude of the medical man to the patient if an opaque meal, instead of revealing "pylorospasm," "duodenitis," or "no evidence of ulcer seen," results in a report of "ulcer present." Such a patient is put to bed—maybe for as long as three months and is given facilities for the adequate treatment of peptic ulcer which should be available for all cases of the periodic dyspepsia syndrome, with or without signs.

It is indeed fortunate that an increasing number of physicians regard peptic ulcer as a psychosomatic manifestation and as one of the later stages of the periodic dyspepsia syndrome. It does seem such a tragedy that the patients who suffer from periodic dyspepsia with symptoms but no signs should be labelled in almost pitiless fashion as "neurotic" whilst patients with similar symptoms but, in addition, signs—especially the radiological demonstration of an ulcer which frequently depends on the technical skill of the radiologist—should receive the adequate therapy which all cases should have received even in the absence of signs. How many cases of peptic ulcer, with or without hæmatemesis and/or melæna, have many of us seen who tell us that they have had these symptoms for years; that they have had a full gastric investigation, excluding gastroscopy, with negative results, and who had been diagnosed repeatedly as "functional dyspepsia"?

In the stage with symptoms and no signs the psychogenic constitution of the patient is obvious. He is bright eyed. He is usually a hyperconscientious, most introspective, active and worrying type of individual who goes to bed with his worries and finds them a disturbing bed fellow. He never stops worrying, takes his responsibilities too seriously and at times lets them get the better of him. Later, as symptoms are accompanied by signs, the emotional aspect of the clinical picture would appear to diminish but it is still obvious to the experienced observer. In other words, the observer is now more attracted to the physiogenic aspect of the case, whereas formerly he was attracted to the psychogenic aspect. It is such an established case which some physicians talk about as being phlegmatic and obviously not of psychogenic origin.

It is appreciated that a minority of the profession to-day accepts the view that the periodic dyspepsia syndrome with symptoms and with or without signs is purely a psychosomatic disorder. Nevertheless, no local or general cause of peptic ulcer or of the symptoms of the pre-ulcer state have been demonstrated in satisfactory fashion. Furthermore the British have reported

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a high incidence of ulcer disease both in troops evacuated from France in the early part of the war and in those stationed in Great Britain.

> "In Germany an interesting study has been made on the ammunition workers of the Krupp factories. Rothe reviewed 7,488 gastric X-ray studies on workers and their families during the three years between November 1937 and October 1940 and observed an increase in the total number of examinations from year to year as well as a relative increase of positive findings.
>
> "Among these findings, duodenal ulcers were the most common. Beginning with September 1940 the number of duodenal ulcer scars increased. An interesting study of the incidence of ulcer perforation during heavy air raids is reported by Stewart and Winser. Investigation of the perforation rate in London from January 1937 to August 1940 showed that the monthly average was 23. In September 1940 and October 1940 (heavy air raid period) the monthly average rose to 64 (J.A.M.A.)".

This would suggest that anxiety at least aggravates the factors producing perforation. In addition it is accepted that emotional stress produces exacerbations of active symptoms in patients who suffer from the periodic dyspepsia syndrome. "If I have any worry it flies to my stomach, doctor." How often have I heard that in proven ulcer cases!

On reviewing 2,500 dyspeptic patients admitted to several military hospitals in various parts of Great Britain Tidy found that 35 per cent of the total were functional in nature.

I consider, from the point of view of recruiting and the selection of individuals for special appointments, it is essential that it should be recognized that the periodic dyspepsia syndrome with symptoms but no signs is merely the early stage of full-blown peptic ulceration, with all its potential complications and attendant evils.

With the relatively high incidence of the periodic dyspepsia syndrome it would be unreasonable to reject all such sufferers from military service. Nevertheless, most will agree that soldiers with ulcers are unfit for active service. In spite of this, at least one German writer believed that even chronic ulcers are capable of permanent cure and that no one should be declared as permanently unfit for military service until an adequate course of treatment has failed. I consider that this is a progressive and enlightened attitude and one which should be commended and recommended.

> "Swiss Army doctors apparently feel that soldiers with healed ulcers can be utilized provided that they are assigned to "diet companies" and to stations in which special diets can be carried out. Practically all writers agree that officers with healed ulcers can render useful army service."
>
> "The present policy in the U.S. Army regarding the acceptance of candidates who have had peptic ulcer is stated by General C. C. Hillman, Chief of the Professional Services Division of the Surgeon-Generals Office as follows:
>
> "In view of the fact that officers are generally able to look after their diet somewhat better than enlisted men it is the policy of this office to accept for limited service applicants for commission who have histories of gastric or duodenal ulcer, provided such histories indicate freedom from activity during the preceding five years and provided further that gastrointestinal X-ray at the time of examination is negative. For enlisted service the presence of an ulcer or a trustworthy history of one at any time

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in the past is considered disqualifying. Because of the unusual habits of soldiers and their inability to give themselves appropriate dietetic care in military messes it has been the custom during times of peace to discharge soldiers when a definite diagnosis of peptic ulcer has been made."

In the days when a soldier "marched on his stomach" I would have agreed with such a policy but nowadays with our highly specialized and ever expanding Army, full of specialists, technicians and intellectuals of all types, we have need of many who suffer from somatic disfunction. In the atomic age we can employ them all in the armed forces in special jobs to suit their intellectual capabilities and their psychogenic susceptibilities. This can be facilitated if we treat such cases with psychotherapy as well as with all the requisite treatment which most consider adequate to-day. This includes in certain selected cases partial or subtotal gastrectomy or vagotomy. Psychiatrists should see all chronic and repeatedly relapsing cases. Should they receive psychiatric treatment—and so obtain a full insight into their condition—as well as physical treatment, there is an increased likelihood of a more lasting cure. At least the incidence of relapse should be materially lessened.

I consider it most fortunate that there is an increasing band of physicians who regard the terms "functional" and "neurotic" in a far different manner than their predecessors and with the same respect that they regard plague, pneumonia and typhoid fever, etc. Many still deny that there is evidence that the periodic dyspepsia syndrome with signs is a psychosomatic manifestation. I agree that there is no overwhelming evidence of this but its very nature, course and behaviour are that of a psychogenic disorder. In addition, we do know that chronic and sustained emotional stress was associated with an increase in the incidence of peptic ulcer perforation and can produce hæmatemesis due I presume, to acute superficial ulceration or erosion.

It is not suggested that all cases of dyspepsia are of psychogenic origin and due care is always taken to exclude, amongst other conditions, tuberculosis, neoplasm, lymphadenoma, hepatitis, renal conditions, gall bladder disease, pancreatitis, chronic appendicitis, splenomegaly, anæmia and conditions associated with local or general increase of venous pressure, etc., etc.

It is my firm belief that if all cases of periodic dyspepsia syndrome with symptoms, and with or without signs, were regarded as and treated as proven cases of peptic ulcer and so regarded as a psychogenic disorder with somatic dysfunction then adequate therapy, i.e. present day therapy *plus psychotherapy*, would increase in great measure the interval between exacerbations and would certainly lessen the incidence of relapse. In the treatment of the periodic dyspepsia syndrome, with or without signs I feel that there is one great omission. That is the failure to explain to the patient the mechanism of production of his symptoms and signs. If the patient be given complete insight into his condition and if it be tactfully impressed on him that should failure attend his efforts—dietetic and/or otherwise—to keep symptom-free, then that failure is his—i.e. a personal failure and should be regarded by him as a mental defeat on his part. Instead many such patients seek medical advice or rather sympathy and while they are in need of the former, the latter should

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be exhibited with judicious care, and should be tempered with diplomatic straight talking. Too much reliance is placed on alkalies and not nearly enough use is made of common sense and plain speaking tactfully done. Of course this might result in some patients changing their doctor but any doctor who really knows his patient and who has a good knowledge of his subject should be able to convince the patient.

I tell my patients that in dealing with all their problems whether they be professional, occupational, domestic, marital, environmental, or financial, etc., they should clear the "IN" tray and "OUT" tray every day and, at the end of the day, have nothing in the "PENDING" tray.

Intelligent patients are ready to believe the psychogenic origin of their symptoms as it is obvious to them how much they suffer during periods of mental stress. The help of a psychiatrist should always be sought in the miserable and chronically relapsing case.

A strong plea is made that all cases of the periodic dyspepsia syndrome should, for the sake of uniformity, close study and follow up, be diagnosed as follows:

Periodic	**Dyspepsia**	**Syndrome**	**(Symptomatic only)**
,,	,,	,,	**(Hyperchlorhydria)**
,,	,,	,,	**(Hypermotile stomach)**
,,	,,	,,	**(Pylorospasm)**
,,	,,	,,	**(Duodenitis)**
,,	,,	,,	**(Hæmatemesis)**
,,	,,	,,	**(Duodenal ulcer)**
,,	,,	,,	**(Gastric ulcer)**
,,	,,	,,	**(Perforation)**

If this system were adopted every patient's record card would make interesting reading over a period of years. In such a way this syndrome would be put in its true perspective from the very beginning and so save a "gastric-neurotic" from being treated with the scorn and contempt born of ignorance until he is subsequently shown to have an obvious peptic ulcer on radiological examination or, worse still, until he is laid low and almost dies from a hæmatemesis.

The reader may take me to task and say that there is much that I have written that is not proven and much that is open to question and controversial. With such an attitude I am ready to agree. However, the whole object of the paper is to emphasize the ætiological—or at least associated—psychogenic aspect of the periodic dyspepsia syndrome with symptoms, whether signs are present or absent. If this has been done and if interest in the need for psychotherapy, as well as the usual routine therapy adopted by everyone to-day, has been stimulated then I consider that my object will have been achieved.

The sections inset are either quoted from an editorial on the subject of dyspepsia which appeared in the *Journal of the American Medical Association* during the war or extracted from some similar topics in the *J.A.M.A.* For these I make grateful acknowledgment. I regret that I have lost the actual references.

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REFERENCES

For an up-to-date review of this subject I would refer the reader to the March and April numbers of the *Post-Graduate Medical Journal,* 1948.

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Clinical and Other Notes.

AIR EVACUATION

An Opinion Expressed at the Southern Command Medical Study Period, November 1947

AIR evacuation of casualties in Burma and in N.W. Europe was on a large scale and it is useful to review the results. It is felt that planning for the future must be considered, and the experiences of the war must not be allowed to be lost. We do not know whether any policy for air evacuation in the future is being actually pursued.

The present operational use of aircraft for the evacuation of casualties is regarded as 20 sorties a day in the Corps area. This with light planes would mean the evacuation of only 20 wounded each day and such a small number must include selected wounded requiring life-saving measures. Such a small lift will have no effect upon the evacuation problem.

Air evacuation must at present be judged as a "bonus" and there must therefore exist an alternative channel of ground evacuation. The officers with experience in Burma were especially emphatic about the effectiveness of air evacuation and it is well known that this was of paramount importance. At the same time it must be remembered that this evacuation depended solely upon air superiority, and while it provides a fine example of what can be done under such conditions, it is by no means to be regarded as the normal method in any future war where air superiority may not exist at all or would not be so pronounced.

We cannot therefore rely upon air evacuation alone, but must have an alternative ground channel of evacuation. This alternative channel must be 100 per cent effective and will follow the medical set-up in the field as we know it.

Experience of air evacuation in Burma brought out certain aspects of the problem.

The problem must be divided into:

(*a*) Forward evacuation;

(*b*) Rear evacuation from Corps to L. of C. or Base Area.

(*a*) *Forward Evacuation.*—(i) Light planes were used and helicopters would prove suitable if available in future. Light planes can only carry one case if they have to operate from strips 200 to 400 yards long. In Burma light planes were allotted for medical use exclusively, but they are in fact mobilized as the communication flight of aircraft allotted to Corps. Their rôle is primarily communication and secondarily medical.

(ii) It was considered that air superiority was not essential for planes of this nature in the forward area, as they would go at tree-top height and fly between A.D.S. and C.C.S.—the distance envisaged would be from 10 to 20

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miles. It was thought that such a plane was no more vulnerable than a motor ambulance. This view needs criticism by R.A.F. before it can be accepted.

(iii) The future would lead us to demand a specified number of light aircraft or helicopters allotted to a Corps exclusively for evacuation of casualties. Planes would have Red Cross markings. The whole organization might be linked to Medical as an Air Ambulance Wing, the counterpart of the Motor Ambulance Convoy. The piloting of these planes by non-medical R.A.M.C. is an attractive idea on the lines of the R.A. pilot officers for artillery observation planes. This proposal may be unattainable owing to administrative difficulties but could be explored with an eye to the future.

(iv) One point in the forward evacuation from A.D.S. by air must be emphasized and that is that there will be no night evacuation. All casualties brought to A.D.S. at night will have to be evacuated by road.

(*b*) *Rear Evacuation from Corps to L. of C. or Base Area.*—Up to date the evacuation from Corps medical units to the rear has always been carried out by transport aircraft which otherwise have to return empty to their base. Their rôle for evacuation of casualties is therefore a secondary one and this affects the evacuation problem. *First*—The number of aircraft bears no relation to the number of casualties. There may be too many aircraft or there may be too few. The time of arrival of aircraft is also uncertain and these factors lead to administrative difficulties, to overcome which, it has been found essential to establish a medical unit close to the airfield to act as a "cushion," where casualties can be held pending the arrival of aircraft. *Second*—The aircraft carry out sorties from airfields at an air-transport base as distinct from a medical base, and therefore either:

I. The patients require ground transport from the airfield at the air transport base to the medical base, or

II. The medical base must be located at the air transport base.

The second alternative was nearly always adopted in Burma. *Third*—The transport aircraft are not protected by the Red Cross and therefore liable to be shot down by the enemy. If our air superiority was not pronounced it might not be justifiable to utilize such aircraft for casualties.

(*c*) With full scale air evacuation as existed in Burma, it was possible to do away with the general hospitals on the L. of C. altogether except for local bed cover. The lift was from the Corps medical units right back to Advance Base, and this allowed of the grouping of hospitals in selected medical areas near airfields. The rapidity of evacuation allowed early treatment of patients and the cutting out of general hospitals on the L. of C. simplified the administrative problems. It overcame the method of evacuation whereby the casualty was evacuated from one hospital to another all down the L. of C. chain, never spending more than a few days in each place, and so preventing any continuity of treatment.

Ambulance aircraft marked with the Red Cross are likely to become the normal method of evacuation of casualties in the future. At this stage it is only possible to suggest an allotment of ambulance aircraft which bears relation to known factors such as the average likely availability of aircraft, the man-

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power and ground organization involved. The advantages of having ambulance aircraft for exclusive use of the medical services are: *First*—Ambulance aircraft can be called forward as required to evacuate a stated number of casualties. There is no delay in evacuation and the need for the medical unit acting as a "cushion" may not be necessary. *Second*—Ambulance aircraft will fly from the Corps medical area direct to the medical base. There must of course be airstrips at both of these locations. The question arises here whether it would be operationally possible to build air-strips exclusively for medical use. If this is not possible then the medical bases and area would have to be located at the air transport base. Such a set-up as the exclusively medical base at Le Treport in 1939–40 would not be a possibility and as this was an important factor in medical policy, the feeling is that an exclusive air-strip for medical use in such a case is justifiable and must be envisaged in the future.

Our recommendations as a result of discussion are as follows:

(i) *Forward Evacuation between A.D.S. and C.C.S.*—Ambulance aircraft to be allotted to Corps on the scale of 32 light aircraft (carrying one patient) or 16 helicopters (carrying two patients). Of these 32 aircraft, 20 would be airborne at one time and 12 under maintenance, and for helicopters, 10 airborne and 6 under maintenance.

(ii) *Rear Evacuation from C.C.S. to Base.*—Ambulance aircraft to be allotted to Army on the scale of one squadron of Hastings, or similar type, which carries L. 32 and S. 24. It is pointed out that three or four loads of this nature is the equivalent of a hospital ship which in comparison is extremely slow and heavy in overhead charges, crew, fuel, etc.

Summary

(*a*) Air evacuation can only be regarded as a "bonus" at present and this will continue until ambulance aircraft are allotted for the evacuation of casualties at some date in the future. This is a policy which is bound to come, it is felt, within the next ten to fifteen years.

(*b*) While air evacuation is a "bonus" the present ground organization for air evacuation is essential. Motor ambulance convoys, hospital trains and hospital ships must be mobilized on the present scale. Even when ambulance aircraft are provided it would appear that a ground organization is still necessary though this would not be needed on anything like the present scale. The reason this ground organization would still be required is because aircraft may be unable to fly owing to bad weather, and enemy air superiority may make the operation too dangerous. It is, however, anticipated that the Geneva Convention will agree on the necessity for allowing Red Cross protection for ambulance aircraft and at medical airfields.

A dual organization for evacuation is therefore always necessary—and such an organization must of necessity prove expensive.

It would be a difficulty with our present knowledge to say what exact number of medical transportation units would be necessary in any future war if ambulance aircraft could be counted upon to carry out the major rôle of evacuation, but thought must be given to this problem to enable a balance to be struck.

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EVACUATION OF WOUNDED DURING OPERATIONS INVOLVING THE USE OF ARMOURED PERSONNEL CARRIERS

Being a note taken from Southern Command Medical Study Period, November 1947

The following is a report on my experiences in the use of "kangaroos" or armoured personnel carriers as asked for by D.D.M.S., Southern Command at the R.A.M.C. Study Week in November 1947.

My experience is limited, and amounts only to knowledge of, but not participation in, one small operation and to planning for future operations. Furthermore, as it took place over three years ago, my memory is none too fresh on certain points, and I cannot vouch for the complete accuracy of all details.

It might be well to explain at the outset that a "kangaroo" is simply a Sherman Tank which has had the turret removed.

The first occasion on which I had any contact with these vehicles was shortly after Christmas 1944, and concerns operation CYGNET. At this time, the 8th Army had just taken Faenza on the River Lamone; and all enemy had been driven back over the next River—R. Senio, except for a large "pocket" to the North of Faenza. It was to liquidate this "pocket" that operation CYGNET was designed. It involved an advance of two to three miles from the neighbourhood of Faenza up to the river bank. The country was close, highly cultivated and intersected liberally by drains and wide ditches. Roads were heavily mined. A hard frost rendered the movement of AFVs possible.

The force allotted for the operation was one battalion of Infantry (2/6 Queens) carried in "kangaroos" and supported, to the best of my memory, by one Tank Regiment (this last may not be quite accurate but it was certainly not more than two Tank Regiments).

At this time I was Commanding the Field Ambulance with 169 (Queens) Infantry Brigade, and I was asked for advice on this operation in which only one battalion of our Brigade was taking part. The RAPs were being cleared to an ADS in Faenza by the Light Field Ambulance of the Armoured Brigade whose Regiment was committed, so that the sum total of my responsibility was to advise the C.O. and M.O. of 2/6 Queens on evacuation within their Regiment. After discussion the following plans were agreed upon:

(1) The M.O. would be allotted one "kangaroo" for his RAP and this would move with TAC Bn. H.Q., so that the M.O. would constantly be both "in the picture" and in communication with the Companies. Furthermore everyone would know where to find him.

(2) I managed to obtain through the A.D.M.S. three White Scout Cars (half-tracks) for the Battalion. These were borrowed from Armoured Regiments which were not at the time committed. They were to be used for evacuation from the Companies to the RAPs.

The operation when it took place, was extremely successful, and success was accomplished with very little fighting. There were only two casualties—both very slightly wounded—who returned in their "kangaroos" at the end of the

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operation. This was extremely fortunate as it was found that the half-tracks, owing to the difficulties of the terrain, had the greatest of difficulty in keeping up with the Armoured Personnel Carriers and in the majority of cases were quite unable to do so.

After this successful operation "kangaroos" began to loom very largely in our lives and, although we never again fought with "kangaroos," we indulged in large numbers of exercises, demonstrations and discussions on this weapon. At one of these discussions the medical aspect of the problem was very fully discussed, and the following points emerged.

(1) It was unanimously agreed that the M.O. must have a "kangaroo" for his RAP, that this RAP should move along the battalion axis in a series of bounds and that for the reasons given above it should keep as close as possible to TAC Bn. H.Q. It was visualized that the M.O. might, while dealing with casualties tend to get left behind a bit, but as long as he continued along the axis then.everyone would know where to find him.

(2) The question of transport of casualties then arose. It was pointed out that half-tracks had not been successful previously because of their inability to follow the "kangaroos," and it was agreed that these were not satisfactory. If not half-tracks, what then? The obvious answer was more "kangaroos". This one, as might be expected, was very quickly disposed of! It was pointed out that "kangaroos" were for transporting fighting troops, that they were in very short supply in the theatre, and that G policy on a high level had forbidden their use for wounded.

I then suggested to the Brigadier that Bren-gun Carriers should be used. We already had in the Brigade one Bren-gun Carrier Ambulance for each battalion. This carrier was converted by removing the tool boxes and ammunition lockers at the back of the vehicle. In this way, after fittings for stretchers had been inserted, one stretcher case could be carried on each side of the vehicle between the gunwhale and the engines. The patients are low down in the vehicle and are protected in front and at the sides by armour plating and it is a reasonably comfortable method of transport as the carriers ride over rough ground. This was a popular method for transporting wounded, and was much used in the Infantry Divisions in Italy. Furthermore, I knew that the New Zealanders had been using this method with success for evacuating from their Armoured Regiments. It seemed to be generally agreed that these could follow the AFVs without difficulty, and eventually this method of transport was agreed upon.

(3) It was agreed that evacuation from RAP to ADS would be by Field Ambulance Stretcher Jeeps or Ambulance cars. I was a bit dubious about this, and in the event of our being actually committed to an operation, I would have asked for a few half-tracks for the Field Ambulance. I shall refer to this point again later.

(4) We carried out various loading experiments with "kangaroos" and found them too awkward vehicles for carrying wounded. As far as I can remember one could only load one stretcher case into the "hold" of the vehicle, and that required a good deal of manœuvring of the stretcher. Three more could be

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carried transversely across the top of the vehicle, but these of course were not under cover.

Discussion

I find it very difficult to comment on the evacuation of casualties with this type of weapon, as I have had no experience of fighting with an Armoured Division. It has always seemed to me that the evacuation of casualties from armour when considered in the abstract presents the most awful problems, but when one is presented with the actual conditions those problems would appear to resolve themselves without difficulty. The evacuation of casualties from Armoured Personnel Carriers appears to differ in no essential principle from that in an Armoured Regiment.

There is only one point which seems to me to be difficult and this may be due merely to my own lack of experience, and that is the evacuation of casualties from RAP to Field Ambulance in an Armoured break through. We are told by those well qualified to speak that this is always possible with "soft" vehicles, and we must accept their opinion, backed as it is by long experience. But though this is possible is it always "really necessary," and are there not some occasions when the provision of Armoured Ambulances for the journey from RAP to Field Ambulance might avoid loss of life? I can think of situations in Infantry work when this might have been so, and I feel that the provision in the Field Ambulance Scale of a few (say 2 or 3) Armoured vehicles for carrying wounded is worthy of consideration.

NOTES FROM THE ARMY MEDICAL DEPARTMENT

(1) Addresses by Honorary Consultants

Honorary Consultants are giving valuable addresses to the Senior Course and Army Specialists. Brigadier Ogier-Ward recently lectured on "Genito-Urinary problems in the Army," and Brigadier Buxton on "Military Orthopædics." He has kindly agreed to lecture later on Bone Graft. Major Clarkson teaches "Wound Cover" and "Surgical Resurfacing of Burns" to each senior course.

(2) Clinical Meeting at Cambridge Military Hospital, Aldershot

An important medical meeting took place recently at the Cambridge Military Hospital, Aldershot, when a very large audience of medical officers heard a discussion on "Backache in the Soldier" with special reference to prolapsed intervertebral disc" and the investigations in that subject recently carried out at Aldershot and Wheatley. Sir Charles Symonds and Mr. R. Young gave valuable contributions and Mr. Young showed his film. This meeting will be reported in detail in a future number of the Journal.

(3) Co-operation with Chaplain

The Director of Army Psychiatry with the Reader in Psychiatry and the Assistant Director from A.M.D. 11 spent two days during the month in conference with the Chaplain-General and some of his staff at the R.A.Ch.D. Depot. Discussions covered a wide range of subjects of common interest to Chaplains and Psychiatrists and methods of co-operation in the care of the soldier's welfare were examined.

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Vitamin Therapy
—its uses and limitations

In pursuit of protein

So accustomed have we become to thinking of Bemax mainly as a rich natural source of the vitamin B complex that its high protein content is not always fully appreciated.

Compare, for example, the *protein* content of bacon and Bemax. The 2-oz. bacon ration should provide, in a week, about 6.2 grammes of first-class protein. *One* daily table-spoonful of Bemax will provide, in the same period, more than 30 grammes of *first-class* protein.

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Reviews

THE ANATOMY OF THE EYE AND ORBIT. Third Edition. By Eugene Wolff, F.R.C.S. H. K. Lewis & Co. 1948. 440 pages. Price 45s.

The book is larger by some sixty pages than the second edition. The original text is intact except where new work has necessitated addition.

Of the many extra illustrations the coloured photomicrographs are very interesting and the inclusion of more pictures of gross brain anatomy in the neurological section is helpful.

New work is mainly on controversial topics. The course of lachrymal fluid across the cornea is denied. A strip-like reservoir of tears hangs under the upper lid which lays on the corneal epithelium a delicate sandwich of mucus, tears, and oil at each blink. Vision is in fact achieved in spite of a perpetual intervening waterfall. There are some fine drawings in support.

Other new work refers to the ciliary muscle action, vitreous structure, substantia propria lamellation, the Zonule of Zinn, the retinal capillary layers and an affirmation of the unilateral cortical representation of the maculæ.

The book is presented in similar form to its predecessor and makes an invaluable addition to an ophthalmic library. C. D. B.

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MODERN PLASTIC SURGICAL PROSTHETICS. By Adolph M. Brown, M.A., M.D. Published by Wm. Heinemann Medical Books Ltd. Pp. 293. 180 Illustrations. Price 35s.

This American book describes methods of overcoming by means of prostheses, those deformities which are beyond correction by plastic surgery.

The planning of a Prosthetics Laboratory and the materials used are described, and the author then goes on to give details of the making of prostheses for deformities of the nose, eye and orbit, the breast, the lower limbs and hand, and ends with a description of methods of making protheses to be implanted surgically. The book is well indexed and is furnished with a Bibliography which takes account mainly of American work in this field.

Experience in work of this kind can be gained only in the Laboratory and at the bedside, but this book will be of value to those whose task it is to keep abreast of modern development in prosthetics material and technique.

D. C. B.

THE CONQUEST OF BRAIN MYSTERIES. By George Bankoff, M.D., F.R.C.S. Conquest Series No. 6. MacDonald & Co. Pp. 174. Price 6s.

This is a sensible and well-balanced account of modern medical psychology. It is eminently readable and extremely valuable for both a medical and a lay public. The uses and limitations of psychiatry are clearly explained and all the important schools of thought are included. The linking of the point of view of the neurologist with that of the psychiatrist is especially well done.

The main headings are: "the brain at work," "the mind in disarray," "surgery of the brain," "new ideas of the mind," "the unconscious and the normal, types and temperaments, personality," and "beyond the mind." The book is scientific and avoids partisanship and uninformed bias. To illustrate this the following quotation will suffice (p. 81):

> "Nothing is more important if psychiatry is to take its proper place in the medical services of the future than that the extreme views of complete denial and complete acceptance of psycho-analysis should be put in their proper place. Blind fear and blind faith are no greater help in medicine whatever its branch, than elsewhere."

One criticism is the error of ascribing to Adler instead of to Jung the theories of introversion and extroversion.

A. T.

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Original Communications.

WORK AND PROBLEMS OF A MEDICAL OFFICER PRISONER OF WAR IN THE FAR EAST

BY

Major J. E. C. ROBINSON
Royal Army Medical Corps

THE purpose of this paper is to discuss some aspects of the work and problems which confronted a medical officer in the Far East during three years and nine months captivity under the Japanese.

When the broad implications of our predicament became clear after the first months of our imprisonment, it was seen that the medical officer's duty would have to consist mainly of preventing disease, with adequate treatment as an impossible ideal and, secondly, to strive for the goal of keeping men alive until the end of the war. At times the second objective was all that seemed possible, and the doctor (especially when the sole officer in a working camp) had often to make decisions on matters of policy as a whole, rather than on specific medical considerations. For example, the requirements of the Japanese for working parties, their mood at the moment or the tact of the medical officer were the indices for sending men out to work. The selection of sick men who would be least damaged by hard work was often a heart-breaking and difficult task, but one that most M.O.s had to face. At other times, but rarely, the M.O. was able to rest men who were only mildly ill.

The fact that so many returned from captivity is a tribute above all to the amazing adaptability of the human body and to the resilience of the human spirit.

Any chance of reasonable relationship between captors and prisoners was slight from the beginning. On our side there was the assumption that as Orientals are "natives" and, by definition, inferior beings, they must be treated only with firmness, if not contempt. On their side was an age-long resentment of white domination in Asia, mingled with an admiration of Western

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achievement, carefully overlaid or suppressed by their own intense nationalism. To such an unfavourable commencement was added an Oriental indifference to death or suffering, a code which deprecates the captured state as unworthy of the warrior, and a military tradition which is inhuman in the extreme, causing even the Japanese civilian to shake the head.

By no means all the Japanese could be called ill-disposed by our standards. One had to accept the idea that, however kindly a Japanese may be as an individual such is his veneration for Imperial authority, as vested supremely in the military, criticism in words or action is impious. The social pressure to which our ethics, even as soldiers, are subject, is absent in the Japanese.

Some of the blame for hard treatment and starvation may perhaps be more justly laid at the door of Japanese Administration than on the Japanese high-level policy. There is a great tendency to consider actions as carried out simply because the order has been issued. It is quite possible for Tokyo to issue orders on P.o.W. diet, etc., without creating an organization for carrying them out. Neither does the watertight nature of Japanese departments make for flexibility. "Let not your right hand know what the left hand doeth," can be carried by the Japanese to extraordinary lengths.

This account describes environmental conditions in five P.o.W. camps in Hong Kong and Japan, with a general description of clinical manifestations of disease in each, together with remarks on diet and deficiency diseases as the writer saw them.

There are serious difficulties in reaching any estimate of the vitamin intake which could be considered accurate, even if the writer had available the figures of actual amounts of food for all camps by the Japanese, for the experimental study.

(1) There were no facilities for the experimental study of vitamin values in the food provided. All such information has been obtained, after release, from tables—which show considerable divergencies. Moreover Roger and Megaw have shown beyond reasonable doubt that the conditions of storage of rice are directly related to its vitamin-B complex content. Much of the rice issued to Ps.o.W. was in a deplorable state, and its vitamin-B content must have varied greatly.

(2) There was a varying amount of waste in times of comparative plenty which would tend to upset calculations.

(3) Another source of doubt concerned our own farm produce, grown in Hong Kong on poor soil, freshly dug from scanty grass-land prepared without manure; possibly producing vegetables with less than normal nutrient content.

(4) Nor was the vitamin content of local produce alone in being suspect. The riboflavine content of corned beef is said in textbooks to be unimpaired, but careful assay in India during the war showed riboflavine absent.

Here then are some reasons for not pushing too far any claims to scientific accuracy of the published figures of vitamin intakes of Ps.o.W. However, it can be said that the amount of vitamins available to the whole camp —and therefore an indication, when correlated with vitamin-deficiency disease

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incidence, of the critical level of vitamin intake—can be estimated within a margin of error whose limits cannot be precisely defined. Such errors assume greater importance when dealing with the small figures of vitamin content than with the larger ones of caloric value.

Another aspect of the matter needs consideration. Although we may secure a figure for the quantity of food representing the individual ration we must remember that this figure may not represent what each man necessarily ate. For this two main factors are responsible. First the universal craving for tobacco. Depending on the cigarette shortage a bowl of rice would be valued from one to five cigarettes, and no amount of warning nor exhortation could suppress the practice. Secondly, gambling with the contents of the Red Cross parcels was a most popular pastime with "trading" of items as a very close second, resulting often in a most unbalanced distribution. One or both of these latter habits seemed to be universal amongst the American troops. Not infrequently individual taste was the main criterion in exchange. For example, a man might perhaps get rid of most of his parcel for jam.

Figures for the diet during the last months of captivity, together with weight and account of the men's clinical conditions at that time are available.

Hong Kong January 1942 to April 1944

The climate is subtropical with a mean rainfall of 90 inches (with a summer monsoon), and a temperature range between 45° and 90° F. There were no anopheline mosquitoes in the areas which became internment camps. One Battalion of British troops was already heavily infected with the malarial parasite, but the Canadians were free. The nutrition of both British and Canadian troops was good at the beginning of captivity.

All troops with the exception of the Canadian were acclimatized. The first camp to be described had been built eighteen months before the Asiatic war as an internment camp for refugees from Canton. The design will be described in connexion with the second camp, which was exactly similar. It had been badly damaged during the fighting and used by the Japanese as horse lines. The flush toilet system was choked and the whole area littered with refuse and excrement. This was cast into the harbour which bounded the camp on one side and the area quickly cleared. The deep trench latrines, constructed until the flush system was again working, were quite satisfactory. However, the damage had already been done. The weather was warm over a long period, and the fly eggs laid in the horse manure having become larvæ and burrowed into the loose ground on which the camp was built, began to emerge as flies. The major fly nuisance came from a "controlled tip" used in peacetime and situated within 100 yards of the camp. It seemed to embody most of the features of mismanagement and is worthy of description.

(1) Houses were built practically on top of the tip.

(2) The working edge of the tip was most irregular in outline and large in extent, and for the most part projected directly into the harbour, so that particular face was never covered with earth.

(3) The covering of the tip was loose, thin and irregular. One could see

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the flies emerging from the covering. The condition of the tip exposed its unsuitability in an area dependent on native labour, where European supervision may tend to be casual. It is particularly dangerous in countries where excremental diseases are rife and cholera is endemic, as Hong Kong.

The fly nuisance was of long standing. The writer had visited the camp in peacetime and had noticed the elaborate fly proofing of the kitchen and dining hall, whilst the *fons et origo* near-by remained untouched.

One was able to inspect the tip and, after many representations to the Japanese, the British civilian Public Health Department which was still functioning, was allowed to cover the tip with earth.

This made a great difference to the fly population, but an epidemic of dysentery was already under way. Sporadic cases had occurred from the beginning but, in February, there were always between 40 and 50 cases in the noisome hovel called the "dysentery hospital" which was an appropriated warehouse without any facilities.

The attacks, though smart, were not attended by any fatalities and appeared clinically to be of the bacillary type (although no means of investigation were available). The only treatment they received was magnesium sulphate, with a little bismuth carbonate after the acute phase, which seldom lasted more than two days.

The only food available was rice. When the blood and mucus had cleared from the stools, rice coarsely ground and cooked with excess of water was given to the patients. In convalescence they received a few yeast tablets daily.

The rice issued by the Japanese was supplemented by tinned food brought into the camp by our own men, and food bought from Chinese vendors (looted tinned goods). In February and March small quantities of tubers (but no potatoes) and flour were added by the Japanese.

All prisoners lost considerable weight, and there is no doubt that not only was the diet deficient in caloric value, but in all vitamin content also.

However, during the first three months, only two men presented themselves with complaints recognized as due to malnutrition.

One, in February, showed perifollicular petechial hæmorrhages on both legs above and below the knee, and showed increased capillary fragility. Although his gums were normal he was considered to be an early scurvy, and he responded to ascorbic-acid therapy. There had been marked deficiency of vitamin C in the diet since the beginning of the campaign on December 8.

The second also occurred in February, in an officer who ate very little of what food there was available. He complained of great weakness and kept to his bed. Massive œdema rapidly developed, and tachycardia. He was removed to the British Military Hospital which was still functioning, where he died four days later. This was probably an example of acute beriberi, and was the only one encountered by the writer, though others had occurred a few weeks earlier in other camps.

One has felt surprise that vitamin deficiencies were not precipitated in the dysentery cases, either in the acute stage or the weeks that immediately followed, through the metabolic disturbances of the disease and the subsequent

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failure of absorption. However, there is no doubt that in this manner was the basis of later deficiency diseases laid down. Observation was to show that dysentery and/or malaria almost invariably figured in the history of severe avitaminosis.

An outbreak of diphtheria which occurred two months after the writer had left this camp (in May) was probably related to the extreme degree of overcrowding which obtained. The effects of lack of ventilation were added, since during the winter months the men who were without blankets kept all the windows hermetically sealed at night. In those months the carrier rate must have been rising steeply.

The effect of defeat and hardship on the morale of men inadequately acclimatized, whose brief military career prior to the Hong Kong campaign had been eighteen months' garrison duty in the West Indies, was very dramatic. For the first month demoralization was complete. There was no open insubordination but a sullen apathy, shown particularly in disregard of personal cleanliness and appearance. No effort was made amongst themselves to lighten their burdens by co-operative effort. At this stage there were no working parties for the Japanese, and the men would spend their days lounging around the corners of huts, the only subject of conversation being food.

In late February and March when food became a little more plentiful efforts made to pull the men together began to achieve success. Books began to come in, baseball matches were arranged and camp chores were organized on a rotary system.

Officers' Camp, Hong Kong

This was built on the same lines and for the same purpose as the preceding camp. The design seemed excellent for the purpose and will be described.

These wooden huts lay with the long axis to the prevailing summer winds with the windows East and West so as to avoid the hot summer sun. The windows were spaced six feet apart and there were wide double doors at either end and in the middle, giving the maximum of ventilation.

The roofs sloped to a central peak, where a set of louvres ran the length of the hut. The hut width was about 16 feet—an additional breadth of 2 feet would have been desirable. Unfortunately a space of 6 feet could not be maintained between bed-heads—it averaged between 3 and 5. However, no ill-effects were noted even amongst the batmen, whose beds were almost touching.

The huts rested on a raised concrete base continuous with a level surround and ending in a semicircular drain directly beneath the eaves. This channel was wide enough to carry all the storm water and not deep enough to constitute a physical danger to walkers. There were no rain gutters, a smooth curved surface prevented stagnation and mosquito breeding. These channels eventually joined together and were responsible (together with the sandy gravel on which the camp was built) for keeping the area absolutely dry.

The latrines were of the Asiatic squatting type, with water carriage system. The elderly had difficulty in getting up and down, but amongst those who would use them properly they became very popular. However, 16 for 500 men were not enough.

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The latrine-washing-shower accommodation was under one roof exactly similar in size to the living huts. There were two such units, each of three sections; a central open one with two water points, and two lateral, each divided into two portions, a washroom-cum-shower and latrines. The arrangement had two principal advantages. First the ease of construction on the standard type building, and secondly that no hut in the camp was more than 50 yards from the latrine.

The sanitation of the camp was very carefully supervised and refuse either buried or burnt in a Horsfall destructor. As a result flies did not breed in the camp and cases of excremental disease were few and sporadic. Our one small outbreak of dysentery was probably due to a dump of chicken manure which was breeding flies in the close-by camp farm, which was supervised by a non-medical officer. When this was dealt with our fly population sank again, and the outbreak with it.

At another date one case of clinical cholera, confirmed as cholera by the Japanese, who took specimens, occurred. No one else in the camp was affected, not even the patient's mess-mates, who had exactly the same food. There was no native dwelling near and it is difficult to see from whence the infection could have come, and of course the symptoms of rice-water stools, aphonia, cramps and prostration could occur from violent purging from any cause. The case was not fatal. In the absence of pyrogen-free water he was given intramuscular saline.

The medical personnel took a prominent part in camp administration, serving on all committees and wielding great influence. The canteen committee devised a scheme whereby every man in the camp could have a share in a weekly food parcel sent in from outside friends. Another committee reallotted pay from the Japanese, graduated according to rank so that each man in camp had an income. At one time all the food in the camp was issued already cooked together with the Japanese rations, but this was unpopular and canteen goods were then distributed on a hut basis. Since there was no equality of income those with higher pay had rather more canteen goods.

One case of mild diphtheria without complications occurred in March 194[illegible] By Japanese orders the hut in which the case occurred was separated by barbed wire from the rest of the camp. Shallow trench latrines were constructed and also urinals, food was carried to the hut and the utensils were cleaned in the hut area. This isolation lasted a week. It was realized that the carrier rate was probably high and advice was given on the ventilation generally and the desirability of sleeping head to toe and of living and sleeping in the open air as far as possible. There were no further cases.

Before discussing the deficiency diseases, malaria must be mentioned again as sharing with dysentery the distinction of being the strongest predisposing source. Many officers and batmen had acquired the disease before internment but the writer cannot recall any fresh case of malaria in this camp (partly because 90 per cent had mosquito nets), in spite of the Japanese failure to maintain antimalarial work in the colony.

In the problem of avitaminosis one must not take too seriously the speci[illegible]

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assignment of symptoms to any one particular deficiency, common as it is in the literature. Various authors on a basis of experiment have ascribed nutritional amblyopia to vitamin-A deficiency (now discredited), thiamin and nicotinic-acid deficiency.

Stannus (Lumleian Lecture 1944) considers that a "capillary synergia" due to hyporiboflavinosis causes retrobulbar optic neuropathy. One's doubts on the ultimate value of this tendency are strengthened on reading "The peripheral neuritis in pellagra cannot be relieved by nicotinic acid though it can be by thiamin" (Lewy, Spies, and Areng, 1940).

It is as well to emphasize here that nutritional deficiencies encountered clinically and not experimentally are invariably multiple. As Lombroso said of pellagra "There is no disease, only the diseased."

Improvement but not cure was the writer's experience in general following therapy with a single dietary supplement. Experience stresses the need for comprehensive dietary therapy.

The General Headquarters (India) Medical Research Organization investigated some neurological syndromes in Indian repatriated Ps.o.W. without throwing much light on the ætiology. Those cases presenting marked pellagrous or hyporiboflavinotic conditions received the appropriate vitamin and those where peripheral neuritis was prominent, thiamin—all in addition to a rich diet. Results varied. All showed some degree of recovery, which might have been due to the rich diet alone. The amount of recovery appeared to depend more on the duration of the lesion, its intensity and on its site than on the specific therapy. Cord lesions, for example, were least affected, as one would expect.

Nutritional-deficiency conditions in the officers' camp were not severe in degree.

It is impossible to estimate with any degree of accuracy the caloric, protein, carbohydrate, fat, or vitamin content of the diet in the camp for the period under review, since canteen distribution under the circumstances already detailed could not be uniform and because, though additional food in the form of a share in weekly food parcels was indeed available to everyone, the quantity varied greatly. It is, however, fair to say that the caloric value was not grossly deficient (between 1,800 and 2,500 calories a day), but that protein was low, fats almost non-existent, vitamin A was low until the farm was producing in the spring of 1943, and the diet was certainly inadequate in the B-group vitamin.

Our supply of vitamin preparations was small and mostly smuggled into the camp from outside civilian sources. Thiamin was so low that it was reserved for retinopathies and special cases. We had a little nicotinic acid, but not enough for the larger oral doses, so it was administered intramuscularly in buffered solution. The Japanese sent in some Red Cross supplies of vitamin-A caramels. There was no riboflavin but small supplies of peanut butter reached us from outside sources.

A certain amount of night blindness (due perhaps to vitamin-A deficiency), was present, and was most marked in a group of officers transferred from a bad camp in February 1943. So marked was it in one victim that he had to strike a match once during the night to assure himself that he had not gone blind.

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Some degree of peripheral neuritis was almost universal in the camp which showed a loss of pain sensibility below the knees and paræsthesiæ. Calf muscles were uniformly tender to pressure but neuritic pain was less common. Only 2 cases showed further neurological symptoms, one with loss of vibration sense and light touch below the knees and wasting of the peronei on one leg and some degree of foot drop. He had consistently disregarded medical advice on his diet. The other, in the summer of 1943, developed an ataxic gait and a milder ataxia in his arms, in addition to showing the symptoms of peripheral neuritis detailed above. He had had repeated attacks of malaria, but was not unique in this, so there must have been other undetected factors which determined the cord involvement.

He improved considerably over a long period under thiamin, nicotinic acid, peanut butter and occasional eggs. Neither case showed a retinopathy.

Disturbance in the water balance of the body was common amongst prisoners. One may recall the common ascription of œdema in beriberi to changes in the capillary wall. Marked polyuria was uniformly present, due to the great fluid intake. In addition to the large water content of the rice, about 20 ounces of soup and 30 ounces of tea were taken daily. Nocturnal polyuria was sometimes more pronounced than diurnal, particularly in the elderly. Presumably they were able at night to excrete the fluid which had collected in their tissues during the day. In this connexion, though a slight œdema of the feet and legs developed in the majority during the day and had gone by the morning, many cases showed an œdema of the face in the morning which disappeared during the day. There is also the possibility of some hormonal (pituitary) disturbance, presumably as a result of the diet. That 4 young men out of the population of 500 developed a gynæcomastia makes an endocrine imbalance an obvious guess.

It is not thought that the œdema in this camp was due to an hypoproteinæmia. Abelin and Rhyon report a case where normal protein blood chemistry was maintained on a diet of 1,600–1,800 calories a day, with a daily protein intake of 30–40 grammes, and T.T. Sohen does not mention œdema in his 1943 study of 11,338 Chinese soldiers, whose sole protein was derived from 993 grammes rice daily. Though this was considerably greater than our rice ration we had protein supplement denied to the Chinese. Moderate work did not seem to play a part in the inception nor degree of œdema which was not particularly evident in either the farm workers or batmen.

In this camp cases of "electric feet" did not go to the extreme length of pain and distress experienced in other camps. There were some complaints of burning and shooting pains in the feet, legs, worse at night, and a fairly common experience, which the writer shared was that the feet became so tender that to step on a stone unless wearing a thick shoe, was a very painful experience. The skin of the foot became soft and had the pink flesh of a baby. The one severe case of "electric feet" we had, a transfer from another camp, presented a marked atrophic skin and a dusty flush from the accompanying hyperæmia.

Although other observers have reported improvement with thiamin this case responded only to nicotinic acid, thiamin having been tried without effect.

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From the first few months of captivity tongues became progressively cleaner and smoother, but, in the early summer of 1943, there was an outbreak of sore mouths, the incidence being higher amongst the gardeners and more energetic batmen.

The features varied, some tongues showed patches of swollen papillæ, others were uniformly smooth and shiny. All were very red and fissured, a few were swollen, and some showed ulcers in the fissures. The degree of pain which brought them to the M.I. Room varied from a mild to a severe burning on smoking or eating. An abnormal appearance of the tongue until the end of captivity was the rule among prisoners, though the writer cannot recall complaints of symptoms after this outbreak. One was frequently astonished that such raw, smooth, and fissured tongues, noticed as part of a routine examination for some other cause at a later date, should have caused no pain. Seen frequently in this outbreak was an associated angular stomatitis. One or two had excessive salivation and one a denuded shiny surface to the upper and lower lips, their angry red colours due to underlying dilated vessels. An occasional association was a very painful sore throat which made swallowing difficult. Examination showed dilated vessels below the mucous membrane of soft palate and pharynx. The hard palate appeared normal, sharply separated by its posterior edge from the crimson soft palate.

There was no striking correspondence between the sore mouths epidemic and the cases of scrotal itching which shortly preceded it. This was also found more often amongst the harder workers. An eczematous condition developed in the worst cases, presumably due to scratching.

The results of what little therapy we could use on these conditions bears out observations on the interrelationship of vitamins. The one case which responded to thiamin has some bearing on Sure and Ford's work in 1942, demonstrating that in cases of thiamin deficiency there is a pronounced disturbance of riboflavin metabolism. A borderline case of hyporiboflavinosis may be made manifest by thiamin deficiency, and thiamin therapy may prevent the symptoms of insufficient riboflavin intake.

One or two cases of sore mouths responded to nicotinic acid, but the majority were unaffected. The worsening of symptoms of the hyporiboflavinotic element said to occur when nicotinic acid is exhibited (due to its vasodilator action) was not noted. The camp-made yeast seemed to have no effect, but peanut butter brought about improvement to mouths and scrota though supplies were neither large nor lasting enough for adequate treatment. After an initially acute phase the cases did not get progressively worse, and settled down into being a part of the general picture of ill-health.

One Portuguese (dark-skinned) victim showed in addition the dusky discoloration and brown pigmentation of pellagra, but no bulbous formation. It cleared up with treatment, but as commonly observed with pellagrins in the Orient, the rash recurred in the spring of the following year.

An almost universal skin condition was a smooth scaliness, best likened to crazy paving and most common on the legs. Some showed what was thought to be an extension of this process, a thick dry and roughened scaliness at the

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axillary folds and other areas likely to be rubbed with clothes such as thighs and forearms. At the apices of these rough irregularities there were minute quantities of brown pigment as the projections of the top of a potato pie might be burnt in the oven.

From the fifth month and for the following year skin ulceration played a prominent part in camp life. The largest was the size of half a crown, and they were always below the knee, commonly around the ankle and never on the foot where œdema would be controlled by the shoe and the skin protected from injury. A bite or scratch would be the commonest beginning, followed by the signs of inflammation, and considerable pain and œdema, together with a hæmorrhagic vesicle which burst about the third day leaving an ulcer. In the chronic state the ulcer had either a clean or a wash-leather base; a serpiginous outline and always a punched-out appearance. Under ordinary conditions one would have thought of syphilis immediately. Presumably a combination of infection and devitalized tissue was responsible. The only two successful dressings we found were iodoform and sulphanilamide powder, applied as early as possible.

The camp was in the hottest area in Hong Kong but although many men had their hair clipped off and wore no hats there were no cases of heat exhaustion or heat stroke, however low our salt intake was. Neither was there a single example of prickly-heat—a peacetime scourge in the colony. Probably more important than our reduced metabolism was our lack of clothes, permitting free ventilation and evaporation (the normal summer wear being a pair of shorts or a G string).

Identification of the cause of the diarrhœa so prevalent in captivity was not easy. The effects of malnutrition (traditionally nicotinic-acid lack) in causing atrophy of the gastro-intestinal mucous membrane was seen at post-mortem examinations in other camps, and doubtless played its part.

Without a microscope one could only guess at the prevalence of intestinal parasites. That amœbiasis was present was virtually certain from at least two long-standing cases of dyspepsia, and intermittent diarrhœa in which blood was eventually detected, and who responded to emetine.

The writer feels that a large number of cases was due to a carbohydrate dyspepsia. Where undigested starch reaches the cæcum and ascending colon it is attacked by bacteria with the formation of CO_2 and organic acids, whose irritation causes diarrhœa (Hurst, 1938). The diarrhœa is frothy with escaping CO_2 and was very commonly seen.

Symptoms referable to the eyes began to attract attention in the autumn of 1942, and an eye clinic was established by an I.M.S. Officer at which the writer assisted. The history of every case was recorded with special reference to previous illness, dietary peculiarity and any access to additional food. We were lucky in having test types, and each case had his near and distant vision together with his near point noted. Where failure of distant vision (not due to refractory error) was present a chart of the visual fields was prepared. A perimeter was constructed, but as the changes were found to be central or paracentral a Bjerrum screen was considered better for the purpose, and replaced

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the perimeter. Examination of several symptomless controls revealed a striking constriction of visual fields for green and red. All retinopathy cases were subjected to ophthalmoscopy. Unfortunately all the notes, together with the charts of all the fields taken, were destroyed by the Japanese.

The conditions presented were night blindness (already mentioned), corneal ulcer, conjunctivitis, increase in refractory errors, "ciliary atonia" and mild and severe cases of retinopathy. Space does not allow discussion of all of these, but the number of corneal ulcers was not large enough to constitute a camp disease, and there appeared to be an increase in existing errors of refraction, estimated by an inmate of the camp experienced in refraction, who had an ingenious method of doing it.

The term "ciliary atonia" was coined for a condition in which the essential was the blurring of print after reading for a variable period yet without any impairment of distant vision. Subjective symptoms were, or might be pain in the eyeballs, headache, lacrimation and discomfort after close work. It appeared about the same time as the retinopathy, and sometimes in the same patient. The response to thiamin therapy was marked, but untreated the condition varied considerably from time to time in the same man. Thiamin was given to the first few cases only, because supplies were small and the condition did not promise (in theory) lasting damage. There was no indication that untreated "ciliary atonia" progressed to retinopathy.

Nutritional retinopathy was viewed with some alarm. From autumn 1942 to April 1944 the writer saw some 120 cases. Each October–March period brought a crop of fresh cases without any outstanding dietary change to explain it, nor were the last series of cases in worse shape than the first. Features which emerged from the history were the frequency of an antecedent malaria, dysentery or war wound which had suppurated, and that moderate exercise did not predispose. In fact only one batman showed the condition and none of the gardeners.

The proportion of older men to the young amongst the sufferers was not greater than that obtaining in the camp as a whole, but the lesions in the elder seemed more severe and developed more quickly than in the young.

The subjective symptoms were similar to those of ciliary atonia but in addition photophobia was usually present (and persisted as long as the process was active). Two or three complained of double vision. Some would say the print became grey and ran together and the worst cases said that the centre of a long word appeared to be missing.

The signs were two, failure of distant vision and the presence of central or paracentral scotomata. In mild cases visual acuity might fall to six-ninths (6/9) or even six-eighteenths (6/18), remaining stationary, fluctuating for a period and then return slowly to 6/6 in both eyes. The time taken varying from a few weeks to a few months. Of these some cases showed scotomata. All were small and relative, that is the red or green spots appeared greyish-white.

The vision in severe cases might be down to 6/36 or 6/60 when first seen or, more rarely, deteriorate to that level within a few days. Recovery was slower than in the milder cases and more limited in extent. Scotomata were always

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present, the larger they were the more impaired the vision; and were either relative, or, fortunately very rarely, absolute, when the spot was not appreciated at all in the scotomatous area. A scotoma was not observed to develop in a case under treatment. Ophthalmoscopic findings did not correspond with the severity of the symptoms. There was physiological cupping in all cases, somewhat tortuous vessels and constriction of the vein where the arterioles crossed them. The temporal pallor reported by some in 1945 was not observed. The discs appeared hyperæmic, and the general picture was that of hypertension.

When once cured or stabilized there seemed no evident tendency to relapse though this might have been masked in severe cases by the maintenance doses of thiamin they received. This was in line with observations on the deficiency diseases as a whole where, if the patient survived, the lesion did not progress beyond a certain point, and acute symptoms would die down.

With signs of mild peripheral neuritis so common in the camp a convincing correlation between the retinopathy and beriberi was difficult to demonstrate though we felt the connexion was there, visualizing a neuritis of the ganglion-cell layer of the retina. However, neither of our severe cases of beriberi showed a retinopathy. The retinopathy preceded by many months the nicotinic-riboflavin type deficiency, and neither nicotinic-acid therapy (40 mg. intramuscularly) nor vitamin A in fairly large doses produced any effect over long periods. The measures we relied on were intramuscular and dietary supplements. We found the most economical dosage to achieve results was 2,500 units of thiamin on alternate days. Higher and more frequent dosage did not appear to achieve better results in the short period (of necessity) under trial, and a fall in efficiency was seen with dosage of less than 2,000 units.

Thiamin relieved the subjective symptoms speedily with the exception of the photophobia which seemed to persist. Whilst in the mild cases visual acuity returned with treatment to 6/6, and the severe ones were improved, there was no corresponding change in the size of either the relative or absolute scotomata.

Our second weapon of attack on the conditions was an increased diet. When in season tomatoes were given to all cases. All eggs from the farm were devoted to hospital and eye cases, and all severe cases and many mild cases sometimes had one a day. To those who gave us most concern we were able to give ½ pint of milk a day at some periods. All cases were advised to wear dark glasses.

During February 1943 some four months after the condition became recognized and in a time of relative and temporary plenty, we were able to carry out a small experiment. Six cases of varying severity were chosen and a further six whose condition paralleled the first series as closely as our material permitted, were used as controls. Both groups were given 2,500 units of thiamin every other day. The control group fed on camp rations and whatever canteen supplements they had been accustomed to buying, and the group under trial were given a riceless diet of about 3,000 calories a day, consisting of bread (white flour and atta), 2 eggs and ½ pint of milk daily, bully beef and a liberal supply of fresh vegetables. General conditions limited the trial to a fortnight but the results were interesting. Both groups showed improvement, but the cases on "normal" diet showed a quite definite improvement over the controls in distant vision. Scotomata, however, in both groups were unaffected.

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Several questions arise from this small experiment—and one may add others from a consideration of the condition as we saw it. Subsequent perusal of some of the literature has not thrown much light on the subject.

(1) Is the condition due to a substance in rice? (Modern opinion seems to be against this).

(2) Had the experimental diet been continued indefinitely would the scotomata (being "caught early") have cleared up completely?

(3) Did the fact that with the experimental diet a greater degree of recovery was noted though both groups were receiving thiamin mean that: (*a*) The effect of a combination of naturally occurring vitamins is superior to the administration of the one synthetic vitamin—which does not mean that vitamin-B_1 shortage is not primarily at fault; (b) Is another factor than B_1 lack, known or unknown in the diet responsible? Stannus says that hyporiboflavinosis can cause the condition (Lumleian Lectures, 1944), but cases of retinopathy occurred considerably before the symptoms of hyporiboflavinosis, nor was there any evidence of connexion between the two.

However, we did find that thiamin improved distant vision (in mild cases even to normal), which, since we could exclude refractory errors, meant that the retinal condition responded. Whether the partial response in the severe cases was due to inadequate dosage or irreversibility of the process it is impossible to say in the present state of knowledge. One must bear in mind that we did not prove that improvement did not occur without thiamin and also the possibility that the improvement with thiamin was another example of the interrelationship of vitamins.

Special weight should be given to the views of Kagawa, who in 1938 wrote of the condition amongst the Japanese whose diet resembled in type the P.o.W. He says that it is nearly always found in association with mild chronic beriberi especially where there have been many attacks. He considers it a form of beriberi curable with thiamin, if not chronic.

Japan

Observations on medical conditions in Hong Kong were involuntarily concluded by the writer's removal to Japan. The last fifteen months were spent in four different camps and only salient points will be mentioned here.

The same methods of conservancy were used in all camps. A concrete pit was sunk for several feet. Covering it was a wooden platform with openings covered by hinged lids. The urinals drained into the pit.

For the first week the stench from the latrines was appalling but as the pit began to fill with urine a fæcal crust formed, underneath which anaerobic action took place, turning the pit into a septic tank, and the odour lost its intolerable quality. As the tank became full the liquor was baled out, and by the order of the Japanese used as manure within and without the camps. These allotments became the "murmurous haunts of flies on summer's eve" and throughout the days as well. They bred in their thousands in the latrines and swarmed all over the camp. Doubtless some of the diarrhœa was due initially to the changeover from rice to rice and barley mixture, as the Japanese assured us, but one wonders how much excremental disease was spread by flies. American sources

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report 40 per cent of their repatriated Ps.o.W. as suffering from amœbiasis. It was remarkable that the Japanese, who pride themselves on their hygiene consciousness, paid so little attention to the fly problem and strongly denied connexion between flies and diarrhœa.

Taken on the whole a worsening of diet with widespread diarrhœa and consequent failures of absorption, combined with gross overwork in factories and mines and following on two and a half years' depreciation did not precipitate a widespread attack of acute symptoms. The writer came across no fresh scrotal or oral symptoms, no return of acute "electric feet." In general it looked as if the prisoners had become adapted to the nutritional level of the Oriental coolie, with general ill-health and only occasionally dramatic symptoms (such as 2 cases of cord involvement and 2 severe retinopathies after six months of these conditions), to call attention to their starvation.

In the Ps.o.W. "Hospital" at Shinagawa, two things stood out, one being the excellent manner in which emaciated men stood up to surgery and the rarity of infection in spite of the most primitive conditions of working, and the other the comparatively good state of the open phthisis cases. Men whose X-rays showed marked infiltration and cavitation had neither raised temperature nor pulse, and a normal or slightly increased blood sedimentation rate. One might imagine that starving the patient had also the effect of starving the tubercle bacillus.

At Shinagawa one had the opportunity of seeing several post-mortems on men dying of malnutrition. There were few macroscopic changes but two cases showed gross fatty changes in the liver, which the pathologist said was a common finding.

All revealed a striking atrophy of the mucous membrane of the whole gastro-intestinal tract. The rugæ were missing, the surface was smooth and the whole wall greatly thinned. Here, then, was one factor in the ever-prevalent diarrhœa.

The Last Six Months

All that the space available allows is to consider the effect of heavy work on the prisoners on a known diet, the two yardsticks being the clinical condition and their weights.

In the first three months the men were engaged in light work; this period followed on a year when Red Cross parcels and pilfering from Japanese supplies were available. Calorie value was about 2,000 a day and obtained from barley and rice almost entirely. The men looked reasonably well fed, and the only signs of malnutrition were "raw" tongues (but symptomless), and the universal occurrence of areas of anæsthesia below the knee, of varying extent and intensity. The average weight was 138 lb.

One has more data for the second period of three months. The men worked ten hours a day seven days a week and heavy work in a copper mine. Diet consisted of rice, barley, small quantities of beans, flour, green vegetables and pumpkin.

The Committee of Food and Nutrition, National Research Council of U.S.A. (1941) lays down as an optimum standard:

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	Optimum standard	*Calculate minimum stand. from various sources*	*Food values obtaining in last three months captivity*	
Calories	4,500	4,000	2,300	
Protein	70	50	50	
Vit. A.	5,000 I.U.	1,000 I.U.	2,000	The source of vitamin A was carotene
Thiamin	2·3 mgm.	1 mgm.	0·53	
Nicotinic acid		10 mgm.	7 mgm.	
Riboflavin	3·3 mgm.	1·5 mgm.	0·35	
Ascorbic acid	75	15 mgm.	25	
		Taken from Field Hygiene Notes, India 1945	Calculated from Field Hygiene Notes, India 1945	

On these figures the diet was deficient in the B group of vitamins and in calorie value.

Some authorities, considering the B group and especially thiamin as catalysts in the transformation of energy, calculate the minimum requirements of thiamin as 0·025 mgm. of thiamin per 100 non-fat calories. On this basis the thiamin needed for our non-fatty diet of 2,300 calories would be 0·575 mgm.—very slightly more than our actual intake.

On this diet there was a slight increase in beriberi as shown by an increase in œdema of the ankles and some men complained of paræsthesias. The feet of many men became a little more tender but there was no outbreak of "electric feet" and no acute mouth symptoms, in spite of the low value of riboflavin and nicotinic acid, and the very prevalent diarrhœa which must have interfered with absorption. Noticeable features were the physical exhaustion of the men and a fall in their weights. At the beginning of the last three months the average weight was 138 lb. and at the end of the period it was 132 lb.

At the end of the war men began to put on weight rapidly as food was dropped by U.S. parachutes.

The writer saw many of the prisoners two months after release. Features then observed were a prevalent tachycardia and persistent slight œdema of the ankles; many men showed more œdema than they exhibited during the period of their captivity.

Summary

In this article an attempt has been made to describe environmental conditions as they affected the life of the prisoners of war together with a brief account of the clinical conditions found amongst them.

Any conclusions put forward on this subject of ætiology have been tentative, and a complexity of nutritional disorders has been indicated. The scarcity in treatment of comprehensive dietary therapy has been stressed.

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GROUP THERAPY AND ITS APPLICATION IN THE BRITISH ARMY TO-DAY

BY

COLONEL J. T. ROBINSON, *O.B.E.*, M.D., D.T.M. & H.Lond.

Introduction

Normal man does not exist in isolation but functions as a part of a community. His actions influence the group and his failure to contribute his share in the community must be regarded as a group affliction as well as an individual shortcoming.

Social maladjustment represents a mode of reaction by an individual to his environment. Both intrinsic and extrinsic factors may contribute to maladjustment and the relative importance of these factors in producing social maladjustment varies with the individual. In some, intrinsic factors such as somatic factors, constitutional and personality "make-up" play a dominant rôle, whereas in others, extrinsic factors such as traumatic emotional experience may be prepotent.

Factors in social adjustment may manifest itself in abnormal behaviour and reactions or in emotional disturbances expressed as mental or psychosomatic symptoms.

Such an individual regards himself as unusual and different from others: is often miserable and incapable of living a happy existence, and is psychologically isolated from the community in which he lives. This maladjustment portrays itself in psychoneurosis, mental illness or psychopathic personality. In the psychoneurotic the very feeling of isolation may account for his greatest anxieties.

Successful treatment must aim at breaking down this psychological isolation and fitting the individual to take his normal rôle in living in and contributing to the group.

This can be achieved in many cases by individual psychotherapy. This latter, however, is time-consuming, requiring the establishment of a satisfactory therapeutic relationship between the patient and the psychiatrist.

In view of the numerical incidence of psychoneurosis in the Army and the limitation of trained psychiatrists, individual psychotherapy can only have a limited therapeutic effect. Consideration must therefore be given to treatment in groups.

Nature of Group Therapy

The patient's social maladjustment however often results from previous traumatic experiences in a group, e.g. the family, Army or community. Group therapy therefore utilizes group interaction to enable the patient to recover

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from the effects of these traumatic experiences and to establish a normal relationship with all other members of the group, and to resume his rôle as a useful working member of society. He has to readjust to group living; to agree and disagree; to assert himself and to take being rebuffed; to express his emotions normally, to cope with frustrations and to derive satisfaction in his community.

In group therapy the patient soon sees himself as an individual in social relationship in the group, in which he receives understanding and encouragement.

Bion and Rickman (1943) in their wide experiences of psychoneurosis in military hospitals pointed out that the term "group therapy" could refer to the treatment of a number of individuals assembled for special therapeutic sessions, or to a planned endeavour to develop in a group forces that lead to smooth co-operative activity. The therapy of individuals assembled in groups is usually in the nature of an explanation of neurotic trouble with reassurance, and sometimes it turns mainly on the catharsis of public confession. The therapy of groups is the acquisition of knowledge and experience of the factors which make for a good group spirit. Their object was to show the group that neurosis was their problem and one which would be worthy of study and attack. They stressed the fact that if the recognition of neurosis as a common enemy were achieved then the group would discipline itself to deal effectively with the common danger.

Moreno (1945) stresses the fact that group therapy is always "Group" therapy. That is the group itself becomes the therapeutic agent as a result of the interaction between individuals forming the group.

Group therapy is therefore a special kind of social experience. It can be used for the purpose of re-education of attitudes and emotional drives whereby social behaviour is modified; and may also be utilized to stimulate the release of unconscious urges and emotions thus providing insight to these deeper experiences.

Military Service enforces close relationship. There is no escape. It thus provides a setting which encourages and invites the trial of group psychotherapy. In the first place, military patients have a great deal in common as members of the military Services. They have lived, trained, played, travelled and in many cases fought together, while their presence in military hospitals for the purpose of psychiatric treatment indicates that they have developed their presenting symptoms as a sequel to, or concomitant with, their military experiences.

The usual complicating economic factors which sometimes interfere with civilian attempts at controlled therapy are absent, since patients can be kept under treatment as long as the military situation permits and during treatment need not be concerned with the cost of medical care. These factors plus the apparent growth of interest in social and group problems present an ideal opportunity to examine the possibilities inherent in group therapeutic methods.

Group therapy does not mean that the treatment of individuals can be reduced to the level of stereotyped standardized uniformity. Each individual requires specific individual therapy which supplements group therapy.

Complete recovery in military medicine entails a full return to the situation

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which was responsible or which was the exciting factor in the appearance of neurotic symptoms. The patient must be got well enough to adapt himself to the Army; failing this he should be returned to his pre-enlistment status of social adjustment.

Group therapy is a technique which seems to afford greater possibilities in furthering these aims than individual psychotherapy.

Methodology

The methods of group therapy are as diverse and numerous as individual therapy. For just as each patient presents a problem of specific treatment so each group has characteristics which necessitate careful study and methods of treatment peculiar to its needs. These methods are outlined below.

While an attempt is made to separate them under three main headings for brief descriptive purposes, it is necessary to stress that one or more have to be applied according to the nature and composition of the group.

(1) *Self-education by the Group.*—This method adheres to the principle of centring the group on itself, training it from its desire to be led and leaving it to find its own aim and purpose. It was employed in the Northfield Experiment (1946) dealing with Service personnel who had broken down under the stress and strain of war conditions. All were casualties suffering from psychoneurosis who had either experienced active service or who had failed when confronted with the possibility of having to face it. The brilliant success of this experiment is widely recognized and was due to the co-operation of many eminent and experienced psychiatrists. Their wisdom, learning and deep knowledge of humanity provided a co-operative force in which patients and staff, both professional and administrative, contributed to the socialization of the unsociable, disappointed and unhappy neurotic. It is not either desirable or necessary to describe this method in detail since full information is available elsewhere. Briefly, however, the method laid emphasis on the social aspects of treatment and on the *spontaneity* of the group activities. Patients ran their own ward and their own activities, assembled weekly for discussions on administrative problems and had a large share in formulating hospital policy. Their selected activities based on personal choice brought them into contact and co-operation with other patients. In this setting their behaviour was noticed and the situation manipulated in co-operation with the psychiatrist so as to have the maximal therapeutic effect. Inside this framework meetings of groups of patients were held where individual difficulties and anxieties were exchanged, similar difficulties in others were realized, while the patients became interested and understood the problems of others and so benefited in the solution of their own. Groups consisted of seven to nine individuals assembled in an informal manner in either a ward, consulting room or in the open air. Patients were relaxed and free to smoke. Topics brought forth comprised the whole range of human experience. The onus of responsibility for the solution of problems was thrown on the group, the psychiatrist refusing to accept the rôle of leader. In this the effect was similar to the leaderless group utilized with such beneficial effects to the Army in the selection of Officers. The difficulties encountered and over-

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come make valuable reading for anyone intending to undertake group therapy.

(2) *Talks and Discussion.*—This didactic method has been applied by those experienced in group therapy in various ways. Jones (1944) used this method with two separate aims.

(i) Specific teaching on the central nervous system by lectures and illustrative charts was given so that neurotic patients with somatic symptoms were enabled to evaluate their symptoms correctly and so avoid misinterpretation.

(ii) General education in normal and abnormal psychology with particular reference to everyday problems.

The American Army (1947) employ the lecture-discussion or the question–answer methods. In the former the psychiatrist presents in a series of talks such topics as causes of nervousness, body-mind relationship, the rôle of dependency, insecurity and inferiority, environmental factors as authority and regimentation and misconceptions regarding mental ill-health. These are illustrated by examples and followed by free discussions. The question–answer method is that in which patients place questions in a special box. These are brought up by the psychiatrist at group meetings and discussed.

Military hospitals dealing with casualties arising out of war conditions have employed similar methods with considerable satisfactory results. Since the return of experienced psychiatrists to their normal hospital and private practices these methods have tended to be less extensively employed and their value less appreciated. They have been revived to some degree at Northfield Military Hospital and at the Military Hospital, Shaftesbury. They have, so far as I am aware, never been used at Military Out-Patient Clinica.

Some psychiatrists consider that small preliminary talks should be given daily for about a week followed by discussion on the subject selected. Thereafter free discussion is encouraged on any subject brought up by the group.

(3) *Psychodrama.*—This method has been widely used in America and in England particularly at Sutton Emergency Hospital and the Tavistock Clinic. It has been employed in the treatment of Military Patients at the Military Hospital, Northfield.

In psychodrama therapy the patient is induced to enact various emotionally traumatic episodes encountered during his life. In respect of Service patients such episodes are their experiences during or prior to Military Service. Psychiatrists experienced in this method consider that the patient should on occasions be given an opposite rôle to perform: for example, the aggressive patient should be given a submissive rôle or the man with considerable hostility against officers should be made to enact the rôle of an officer.

Rôle of the Psychiatrist

The success or failure of group psychotherapy largely depends on the psychiatrist. He himself must have enthusiasm and confidence in group therapy and understand its value and limitations or he will fail miserably in employing it.

He is responsible initially for the selection of the group and after careful observation of emotional interaction between members of the group modifies the latter to meet therapeutic requirements.

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As a member of this group he has himself an essential and important rôle, the assumption of which requires patience, understanding, tact and in some instances the admission of inadequate experience and knowledge to deal with a particular situation. Absolute honesty with the group is essential.

This rôle depends upon whether self-education by the group or didactic methods are employed. In the former his main function is to put the members of the group at ease, encourage them to talk and exchange information and opinions, and help them to formulate and interpret their views. The psychiatrist acts as a mediator controlling the degree of spontaneity of the interaction process. This is no easy task for the inexperienced psychiatrist. Foulkes (1946) points out that the latter requires help to overcome his own difficulties and encouragement to face the groups. Once exposed to the dynamic forces within the group he claims that psychiatrists become increasingly aware of these forces. They face the same problems as the group and are themselves members thereof. The psychiatrist must not hamper the spontaneous expression and activity of the group. He has to learn to tolerate anxieties and tensions within himself, resisting the temptation to play the rôle of the authoritative leader but rather submit all problems to the group. He stresses the fact that the more this is done the better is he rewarded by the growing maturity of the group, their increasing capacity to tackle problems by their own efforts, the growth of their self-reliance, confidence and independence. The best psychiatrist is one who keeps in the background and interferes least. Solby in his contribution to Moreno's "Group Psychotherapy" stresses the fact that the psychiatrist must be alert to see that one extrovert does not monopolize the session and that no introvert, though physically present, isolates himself psychologically. He helps to protect the weaker members of the group and to support them in their efforts to gain group security and prevent the aggressive personality from dominating the group. His approach to psychological reactions must be one which embraces the group and deals with common concepts of the group. The formation of symptoms must be clearly and logically explained. If the therapist persists in translating the knowledge he gained in individual psychotherapy to group therapy with no regard for psychological reactions and motivations of the group, he will attain but minimal success.

When didactic methods are employed the psychiatrist may occupy the symbolic position of the wise and just parent, with the group as an encouraging and understanding society. While expounding, in well-considered brief introductory talks, and relating emotional and somatic disturbances, he must never lose his identity as a member of the group. Group sessions must never develop into lectures and monologues. These introductory talks provide information in the better understanding of the ætiological factors of psychological disturbances and centre the attention of the groups on topics relevant to their needs. The psychiatrist must encourage the group to discuss them fully. As knowledge and understanding are gained the group itself produces topics and no introductory talks are required by the psychiatrist who then assumes a similar rôle to that of his colleague in the self-educational group.

To achieve the goal of the social reintegration of the patient, the psychiatrist

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must support all group sessions by utilizing activities such as vocational training, occupational therapy, exercises, games and entertainments to foster the community spirit. To this end he must collaborate and obtain the help and experience of a social worker and/or activities officer. The Northfield Experiment proved the paramount importance of these adjuvants in the treatment of patients in military hospitals.

The positive contribution to the rehabilitation of the patient by the nurses is emphasized by Jones (1948). The psychiatrist should make them feel that they are necessary and should get them to read his notes making the nurse responsible for an allotted number of patients and give her advice in handling them.

He further points out that the group reacts strongly to the attitude of the psychiatrist. When the latter slackens in his work and enthusiasm or becomes mildly preoccupied with outside affairs, the morale of the group declines and progress in treatment is retarded. The psychiatrist's interests in the welfare of his patient is more important than actually seeing them individually.

Selection of Groups

All psychiatrists experienced in group therapy stress the importance of selecting members to form groups.

It is a normal experience of everyday life that people function better in one group than another. Similarly experience in hospitals dealing with psychiatric disorders show that individuals in one group function better than in another. The beneficial effects which the individual derives from his interaction with other patients in a ward can be nullified by his admission to a ward in which he does not "fit in" with the occupants.

Authorities are not agreed as to the criteria for the selection of groups but all stress the necessity of limiting the number of members in order to ensure that emotional interaction includes all members of the group and that no individual is psychologically isolated. Most authorities limit groups to seven to ten persons.

Not all patients are suitable for group therapy, where self-education by the group and the didactic methods of talks followed by discussions are employed.

Some exclude from the group individuals who possess objectionable traits such as ties which might be disturbing to the group. Paster (1944) excludes mental defectives and anti-social psychopaths from the group and most authorities would subscribe to this action. Dewar (1946) excludes the very depressed. Foulkes (1944) included, however, all forms of psychoneurosis: psychopaths, a good proportion of mild psychosis, and organic causes responding to psychotherapy, e.g. epilepsy, epileptiform and choreiform syndromes.

While there are no stereotyped criteria, it is generally accepted that the principle of identification is the basis for selection of those suitable. Various reports indicate that identity of symptoms, of social status or a formulated goal are most frequently employed. The results of these methods appear to be proportional to the degree of identity achieved by the individuals in the group.

Others select patients of similar personality types with similar problems, but

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also introduce contrasting personality types. To foster dynamic interaction of the group the timid is mixed with the aggressive and on occasion a special stimulus is introduced in the form of a particular personality type playing a special emotional rôle in the group.

Dewar (1946) in dealing with military patients used what she described as the "closed" and "open" groups. The former applied to two groups each of which consisted of patients admitted to hospital together. One group comprised those who were given no individual psychotherapy before forming a group. To these groups no new patients were admitted. She stresses the fact that the ideal group is one in which the patients have been admitted together and have worked as a group from the beginning. Such are immediately confronted with the problem of discussion and have the minimum of individual contact with the psychiatrist.

The "open" group was a gathering to which any or all patients could come and go with freedom thus giving continuity of the group but not of the participating individuals. These two types of groups are utilized at Sutton Emergency Hospital.

The group can be started either by requesting the patients beforehand to assemble at a given time and place to discuss freely their personal problems or the patients may be challenged by the psychiatrist without warning either in the ward, recreation room, or other convenient place.

There appears to be no evidence that anti-social psychopaths benefit from any form of group therapy.

All psychoneurotics and some psychotics benefit from psychodrama and Moreno considers that by this method morons can be stimulated to react intelligently to social situations. Jones (1948) in an unselected group obtained convincing results with psychodrama but observed that such a group showed less tendency to discuss their problems.

Therapeutic Mechanisms and Psychological Principles Involved in Group Therapy

Moreno concluded that the therapeutic mechanisms involved were as follows:

(i) Materialization—the patient is provided with an opportunity to give materialization to his imaginary world. The outcast whose ideas are laughed at and rejected gains a feeling of acceptance and self-assurance: the pleasant phantasy becomes a wish-fulfilment. It crystallizes vague fears and anxieties which gains substance and reality so that the patient is enabled to face them, struggle with them and overcome them.

(ii) Abreaction—the patient is enabled to unburden his complexes and conflicts.

(iii) Insight—it provides a synopsis and panoramic view of the patient's own difficulty.

(iv) Training and Adaption—this is provided by the stage. The patient gains confidence and realizes he is safe; the feeling of security thus engendered is carried over into real life.

Jones (1948) uses psychodrama with two main objects in view: Re-education

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and Catharsis. The former to re-create social situations which have caused minor difficulties to patients and act them out; then to discuss subjective and objective reactions by the members of the group and attempt to modify the patient's attitude. The latter to re-enact a strong emotional experience by placing the patient in a situation which resembles the original one and getting him to re-live the experience. The group again discusses the scene and by explanations and emotional support aims at strengthening the patient's ego so that the situation no longer overwhelms him. The patients themselves were encouraged to write and produce a weekly play based on a social problem which they feel to be important. The illustrative cases described are most convincing.

Jones (1944) considers that the combination of discussion and dramatic representation of actual case-histories give the patients rapid insight into their problems.

Evaluation of Group Therapy

While the above methods may be regarded as specific varieties of group therapy it must be realized that it is the interaction of the individuals comprising the group which is of importance. The methods provide a centralized interest and common bond of unity and a stimulus to socialization. In themselves they are only a means to an end, and the benefits accruing therefrom can only be maintained if the daily routine fosters natural social relationships and the capacity to meet with difficulties and overcome them in a normal way. To this end a full daily programme must be arranged. Athletics, recreation, motion pictures and masculine forms of educational therapy are utilized as adjunct therapies to attain this end. Team work is emphasized since this is symbolic of the attitude required when the military patient leaves hospital.

All psychiatrists experienced in group therapy stress the importance of the setting in which the group meets. This should be informal in a comfortably furnished and pleasant room and patients should be permitted to relax and smoke. They further stress the necessity for regular sessions and emphasize that group sessions must not develop into lectures.

It is impossible to produce statistical evidence to prove that the results obtained in group therapy are superior to those of individual psychotherapy. Such evidence could only be elicited after carefully controlled experiments over a long period. It would necessitate a careful study of patients both in and out of hospital and a segregation thereof into those exclusively treated by individual and group therapy respectively.

Fluctuating populations both civil and military add to the difficulties, the latter by the exigencies of Service conditions. It is clear from the evidence to hand, however, that group therapy brings the patient frequently into personal contact and relationship with the psychiatrist. The process of individual psychotherapy therefore is activated and continuous, the depth of effectiveness depending on the relationship between the psychiatrist and the patient. No advantage is gained therefore by laborious procedure in an attempt to separate and weigh in the balance the results obtained by either group or individual psychotherapy.

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From what has been said there is irrefutable evidence that group therapy is based on sound psychological principles, can bring relief and encouragement not only to the individual but to the mass. It is a social therapy dealing with social maladies and social problems. It can itself effect a cure where individual therapy has failed. In the Army it has been more rapid in its effects while it is generally considered that the numbers of men returned fit to units since the introduction of group therapy are greater than those returned after the exclusive technique of individual psychotherapy. Unfortunately no precise statistics are available.

Advantages of Group Therapy

The advantages of group therapy depend to some extent on the particular method employed. The latter must be related to the needs of the different groups and the individuals comprising them. The following advantages have been ascribed to group therapy:

(1) It enables the patient to adopt an objective attitude towards his own problems. He becomes interested in his fellow-patient and tries to help him. He develops a sense of importance in the group; a sense of being needed. Because he can discuss another's difficulties, his own become lessened. He becomes interested and his introversion diminishes. He gradually discovers the satisfaction which he can derive from social adjustments. He becomes socialized.

(2) It provides useful information about the individual in relation to the group, the psychiatrist in relation to the group, and the members of the group in relation to each other.

(3) It helps the patient more than any other method to lose the feeling of psychological isolation.

(4) It enables a larger number of patients to be treated than could be done with individual therapy.

(5) It is of particular value in psychoneurosis when the symptoms described by the patient as unbearable headaches, unbearable thoughts, the dizziness that drives one frantic, the fatigue that is beyond human endurance, are ominously expressive of defeatism. The first psychotherapeutic step is to convince the patient that the sensation can be endured, the impulse controlled and the obsession diverted. This "sales" talk is useless individually where the patient resists or thinks the physician does not tell the truth. In the group this resistance is overcome.

(6) Individuals acquire intellectual and emotional insight more rapidly in the group than in individual sessions. They accept better unconscious motivations more readily and adjust more satisfactorily.

(7) The group provides a foundation for an organized social order with dominant aims, ideas, values and patterns of interpersonal experience.

(8) Material which is embarrassing and stirs up resistance in individual psycho-analysis can be presented to the group and be accepted by the patient. The psychiatrist can study the patients when they are off their guard and can more readily learn each individual's reactions to problems, his defences and resistances.

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(9) In the group, patients will often discuss their symptoms after refusing to divulge them to the psychiatrist at individual interviews. They unburden their personal problems, frustrations and fears. Their pent-up feelings are acted out and released. Their wishes and hostilities are often dramatically expressed. Their conflicts are more sharply defined; the related feeling of guilt and anxiety clarified and reduced. The layers of evasion, defence and rationalization are removed more quickly. There is a continuous flow of emotional support through group relationship.

(10) The group acts by reawakening the libido to outside channels rather than to inner conflicts and fantasies.

(11) It provides opportunities for the testing of various forms of social reality as personified by individual group members, the psychiatrist and the group as a whole.

(12) It provides opportunities for the modification of the concepts of self in the direction of increased self-esteem; alleviation of the sense of failure and to the recognition of constructive capacities. This tends to increase the acceptance of other persons and tolerance for frustrating experience.

(13) The difficulties of the positive transference are less because the psychiatrist remains impersonal.

(14) The patient is usually "accessible" at all times.

(15) It is of value in the education of parents and in the field of child guidance. Parents can be helped to understand their problems more easily without producing resentment.

The Problems of Psychiatric Illness in the Army

It is important to consider the social maladjustment exhibited by military patients who so successfully achieved social and psychological integration.

Foulkes (1946) points out that disturbances or interpersonal relationship exhibits three factors:

(1) The soldier has failed in his ability to perform his duty to a community at war.

(2) He represented a failure of mental hygiene in his unit and psychiatric therapeutics.

(3) He was a failure in his own eyes.

His belief in himself was shattered, he felt ill at ease, had lost confidence, felt displaced and rejected and was "fed up." Deemed unfit to perform any useful function, many were glad to escape the Army.

These factors do not all operate to-day in the ætiology of psychoneurotic illness in the Army. The community is not perturbed if a soldier fails in his ability to adjust himself to the Army. Indeed there is a lurking sympathy for the soldier and a tendency to blame the Army and its attitude for the soldier's failure. The practice of "witch hunting" enables the soldier to escape the opprobrium which would have been his reward under war conditions.

The soldier who seeks interviews or treatment with the psychiatrist under existing Service conditions falls into two main groups. First there is the young soldier inducted into the Army under the National Service Scheme. This man

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has generally no sense of failure. He has no interest in the Army; considering the latter as a burden which must be unloaded and which interferes with his career. Such a one is usually immature and does not understand the purpose of military service.

Secondly there is the re-enlisted regular soldier, most of whom held non-commissioned and warrant officer rank. Such either find themselves occupying positions of responsibility which are beyond their capacity or serving under younger men who have less experience though far more ability. Their feeling of inferiority and inadequacy is beyond their endurance.

The maladjustment of the soldier does, however, represent a failure of mental hygiene in his unit and a failure of psychiatric prophylaxis. It indicates a lowering or non-existence of morale. Some attribute the latter to good leadership, others as a product of the group and the herd instinct, others as a product of the individual. It is that which sustains a man in the face of difficulties and provides him with a purpose in life.

This is a serious situation since symptoms can become fixed and become unconsciously of value in escaping, not merely the responsibilities inherent in military service, but it gravely interferes with social adjustment in civilian life later. Aubrey Lewis (1943) has produced convincing evidence that men discharged from the Army with psychoneurosis had gone downhill; were less usefully and gainfully employed, less contented, less tolerable to live with and less healthy. This was due not to difficulties of obtaining work but due to changes in the men themselves. Only a little over 25 per cent of his cases showed a poor pre-enlistment employment record.

They were, as a group, men predisposed to neurotic illness with its social consequences; the changes in their environment and way of life enforced by military service led to the overt exhibition of what had been only neurotic tendencies or to the exaggeration of their previous neurotic symptoms. The man-power requirements for war made it necessary to call up everyone who could carry out some form of military service and it is really not surprising that men did exhibit these symptoms. It is of interest, however, to note the effects of their neurotic illness in their adjustment to civil life afterwards. The many effective measures adopted by the Army in war are well known. Are these adequate to meet the requirements of the Army of to-day with its large population of National Service personnel?

The problem of psychiatric illness in the Army to-day is a social problem of vital importance to the State. It is a problem not merely of active therapeutics in the relief of established symptoms but one of psychiatric prophylaxis.

The Problem of Treatment of the Maladjusted Soldier

Group therapy can do much in the social and psychological reintegration of the maladjusted soldier not only to enable him to take his proper place in the Army and to be satisfied therein but also to make him a better citizen. It will be of no avail, however, if the purpose of Army Service is not clearly appreciated and accepted especially by all National Service recruits, who form the major contribution to the psychiatrically ill population of the Army.

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Richards (1948) stresses the fact that National Service has provided the Army with an opportunity to teach the newly enlisted recruits the elements of good citizenship and healthy living. This is indeed true and an opportunity not to be missed. It can be successful only if the soldier's emotional reactions and attitudes to Army Service are directed into normal channels. Mental hygiene must be regarded as an integral part of personal and social hygiene.

The reputation of the Army Medical Services in the prevention of disease due to bacteriological protozoal and chemical agents is recognized throughout the Empire. The success achieved is in no small measure due to the didactic approach to combatant officer supported by the co-operation of the General Staff; making unit commanders responsible for their own hygiene; supervised and guided by hygiene specialists. The Army must also accept its responsibility in the prevention of psychological illness. Psychological prophylaxis is exhibited in Child Guidance Clinica and in the concomitant psychotherapy of parent or guardian.

The Army is to the immature National Service man as school is to the child who never before has left the shelter of his home and for the first time for varying reasons finds himself thrown on his own resources in a strange and frightening world. To both the experience is a severe emotional upset. But as Child Guidance Clinica alter the attitude of parents and guardians and thereby prevent children from developing antisocial habits, so the Army can prevent maladjustment and psychological illness in the new recruit. Comfortable beds, good food and amenities; the daily routine of washing, eating, sleeping and employment of leisure, help, but are of no avail unless the young soldier is enabled to understand the necessity for this upheaval and to find complete emotional satisfaction in his new surroundings. Emotional disturbances arising from abnormal thinking induced by unsatisfactory environmental factors become fixed thereby destroying morale and the ability of the individual to adjust to the Army and civil life.

The solution of these problems of the Army to-day is therefore twofold: prophylaxis and treatment of symptoms.

Prophylaxis.—(1) The co-operation of all branches of the Army in assembling all available knowledge and experience to improve morale. In particular to inculcate into the National Service recruit at Army Basic Training Units an identity of purpose and satisfaction in the Army which will enable him to be a better citizen by virtue of his service when he returns to civil life.

In this the Educational Authorities have a unique responsibility and privilege, supported and assisted by the Medical Services and Personnel Selection Branches of the War Office.

(2) The active continuation of mental hygiene in all units necessitating the co-operation of commanding officers and unit officers. This can be achieved by lectures and discussions from and with psychiatrists, officers of the Education Corps and experts in social hygiene.

(3) The careful selection of those N.C.O.s who, having completed their previous regular engagement with the colours, wish to re-enlist on a further

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term of regular service. It would be desirable for all such to be assessed by a psychiatrist before being accepted by the Army. The majority are men who have failed in their adjustment to civilian employment and have sought refuge from their difficulties in the Service.

Those already accepted as re-enlisted non-commissioned officers who show frequent attendances at sick parades with minor troubles should be reassessed by personnel selection officers and reallocated to duties in accordance with their capabilities. Doubtful cases should be referred to psychiatrists.

Active Treatment.—Prophylaxis on the lines recommended will considerably reduce the psychiatrically sick population of the Army. There will, however, still remain a large number of men who will break down during service since it is not possible to exclude all who are constitutionally predisposed to psychoneurosis. Under the National Service Scheme the new recruits comprise large numbers of immature youths who even after careful investigation show stable personalities and good family histories prior to service. Some will break down even with the implementation of prophylactic measures. The dull and backward provide another problem and add to the numbers requiring psychiatric assessment and disposal.

In many therefore psychiatric treatment will be necessary. Such treatment must be rapid in its effects and must be that of socialization. From all evidence available it is clear that group therapy is the most powerful weapon in the armamentarium of psychiatry. Blair (1943) considers that not all psychiatrists are capable of employing it and its use depends on the personality of the psychiatrist. Personality helps but since group therapy is the effective application of well-established psychiatric principles, then all those who profess special knowledge on psychiatry should be able to carry it out. It is doubtful whether the method of self-education as exemplified by Foulkes could be carried out by all psychiatrists. It is, however, suggested that under the guidance of an experienced psychiatrist all should be able to carry out the didactic methods. With the assistance of social workers or activities officers experienced in social work, and with some knowledge of drama, these methods could be augmented with psychodrama. It should therefore be made a compulsory method of treatment by all psychiatrists not only in military hospitals dealing with in-patients but also at out-patient sessions in the Army. The Northfield experiment proved that psychiatrists who never before had employed this method could be taught to do so.

Individual psychiatric interviews are also necessary in arriving at and confirming diagnosis and in eventual disposal. For these reasons they are indispensable despite limitation of man-power and time.

A well-organized daily programme of military activities, athletics and games, occupational therapy and education must be planned and the assistance of nurses and social workers are essential adjuvant in the final socialization of the maladjusted soldier.

If group therapy was more intensively adopted the potential benefits would be increased and measured not only in terms of alleviation of human suffering but also by social and economic benefits and an earlier return of the neurotic

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soldier as a useful working member of society either in the Army or in civil employment.

Summary

(1) An attempt is made to show what is implied in the term "group therapy."

(2) The methods employed, the rôle of the psychiatrist and the selection and formation of groups are described.

(3) The value of group therapy is stressed.

(4) The problems of the Army to-day are discussed and psychiatric prophylaxis emphasized.

(5) The importance of the nurse in treatment is emphasized.

(6) A well-organized daily programme of activities is regarded as a necessary adjuvant in the final socialization of the maladjusted soldier.

(7) The use of group therapy by all Army psychiatrists is recommended, supported when required by individual psychiatric interviews.

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Clinical and Other Notes.

THE EARLY DIAGNOSIS OF INFECTIVE HEPATITIS IN SYPHILITIC PATIENTS UNDERGOING ARSENICAL THERAPY

BY

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THE incidence of infective hepatitis is still greater in syphilitic patients undergoing arsenical therapy than in the general population despite the care taken in V.D. clinics to avoid dissemination of the causal virus. At the present time a diagnosis of hepatitis is seldom made prior to the appearance of bile in the urine although it is recognized that the disease is most infectious in the pre-icteric stage, and the advantages of making a diagnosis at this time are obvious.

Infective hepatitis can be diagnosed readily in the pre-icteric stage by means of the intradermal histamine test of Kline. Unfortunately the usefulness of this test is limited by the fact that early symptoms such as nausea and loss of appetite, which would lead one to perform it, are frequently absent or so slight as to be disregarded by the patient.

In August 1943, when examining records of cases of "arsenical jaundice" it was noted that in the majority of cases a loss of weight occurred shortly before signs of jaundice appeared. During the next two months close attention was paid to the weight of patients on anti-syphilitic treatment, and 13 men were seen who had lost at least 2 lb. in weight in seven days. On the day on which the weight loss was noted they were examined for signs of hepatitis. The liver was slightly enlarged in 8 cases, and tender in 3 of these. Icterus was not present in any case, and none had bile in the urine. These patients were then examined daily, and in every case bile appeared in the urine from seven to ten days. During this two-month period another 4 patients developed hepatitis. 2 of these became ill while having four weeks' rest from anti-syphilitic treatment, 1 showed a gradual loss of weight over many months, and the remaining case did not lose weight.

It was then decided to carry out Kline's test on patients who lost 2 lb. or more in weight within a week. In the next eighteen months 55 men on anti-syphilitic treatment developed hepatitis. 43 of these showed a significant loss of weight. In these cases the intradermal injection of 0·25 c.c. of 0·1 per cent histamine produced a yellow wheal, and all had bile in the urine seven to ten days later. 6 of the remaining 12 cases developed jaundice during a rest period,

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2 lost weight very gradually over many months, while there was no loss of weight in the remaining 4.

The weight lost within a week by the 56 patients in whom a diagnosis of hepatitis was presumed in the pre-icteric stage was as follows:

Weight lost	2 lb.	3 lb.	4 lb.	5 lb.	6 lb.
No. of patients	26	12	9	4	5

(For convenience ozs. have been omitted.)

As has already been stated 8 patients developed jaundice at a time when they were not under weekly observation. If these are disregarded, of a total of 64 patients who developed hepatitis, 56 showed a loss of weight of 2 lb. or more seven to ten days before bile appeared in the urine, and though the number of cases studied is too small to allow a definite conclusion to be drawn, it would appear that syphilitic patients who develop hepatitis while under treatment with the arsenicals, commonly lose 2 lb. or more in weight seven to ten days before bile appears in the urine..

In most V.D. clinics, patients receiving arsenical therapy are weighed weekly, and it is suggested that the use of Kline's test in all cases who show a sudden loss of weight of at least 2 lb., provides an easy and effective method of diagnosing infective hepatitis in the pre-icteric stage.

THE PIONEER HEALTH CENTRE, PECKHAM

BY

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When embarking upon this subject one must understand that, as a result of the research carried out at this centre, a new branch of science has emerged. A recognized name for this does not appear to have been evolved, but a convenient description is, perhaps, "Human Biology."

This experiment that has its base and field at Peckham is concerned not with the study of lower forms of life, as is the academic type of biology, but with man, man's living and his environment. Environment is of equal importance as man himself, in fact the two are inseparable.

The main starting point for the investigations was the contention that health is more than just absence of disease. In the words of an interim report, issued by the centre,[1] "Health is a positive quality emergent from the harmonious working of one's non-diseased organs." The purpose of the experiment is to study health, and the discovery of disease was purely incidental. Although a great deal of work has been completed, we are still very much on the fringe of this new subject.

The present centre was organized and is staffed by a team of men and women doctors, sociologists, biologists and biochemists, etc. Although it is now or-

[1] "Biologists in Search of Material," by George Scott Williamson, Innes H. Pearse.

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ganized on a large scale, it was not so in the beginning. The true origin can be traced to a small family Club in South London. Like Peckham, this district was a fairly representative community. The club was in operation from 1926 to 1929. It consisted of an ordinary moderate-sized house, containing just a consulting room, changing room, and a room for social purposes. It was in fact a miniature Peckham centre, with much the same conditions of membership, without social equipment of any sort.

Not only did this Club provide the justification of the present large and well-equipped centre, but also yielded certain findings of importance. The main ones consist of the following:

(*a*) Examination of the man-in-the-street by modern scientific methods, disclosed disorders of a pathological nature not anticipated by the individuals concerned, or indeed by the scientists themselves.

(*b*) Such disorders, when discovered at this early stage are easier to treat and with more likelihood of success, than in a more advanced or chronic stage.

(*c*) If individuals after treatment, remain in the same environment, then the same disorders are prone to recur.

The small house which constituted the first "centre," was obviously inadequate, so the present building was constructed during 1934–35 for £38,000, including the cost of basic equipment.

By virtue of the originality of the scheme, the instigators had to face difficulties that are not usually encountered by the ordinary research worker. The botanist can collect his specimens from any convenient garden, the experimental pathologist can order more material according to his needs. This was not so with our "human biologists," they had the problem of collecting their specimens. Since in this case they consisted of men, women, and children, the problem was not one that had a ready solution.

To get people to participate in the experiment, it was necessary for them to sacrifice some of their spare time. This being so, it meant that the Peckham Centre had to compete with such commercial enterprises as the cinema, theatre and all the other things that comprise the large and varied field of modern entertainment. In addition to this factor, the centre appeared as an entirely new idea and consequently it was some time before the people grew accustomed to it. All these things tended to give rise to a reluctancy on the part of the local population to co-operate in the scheme.

In addition, there were a number of stipulations that, although essential to the success of the experiment, did not encourage membership. For example, only a complete family could join. This of course excluded the most likely members such as bachelors and spinsters. Unfortunately, these people had to be classed as ineligible. Another stipulation that was rather disconcerting to many people, was the periodical health overhaul, because, quite naturally, this was assumed to be the usual type of medical examination. Many families were subsequently refused membership because they did not live in the district of Peckham. This may appear at first to be unnecessary, but this district was chosen as the site for the centre for the same reasons that the area for the first

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club was chosen. An essential consideration was that here they had a typical cross-section of the community, and one that did not reflect any particular social problem, such as unemployment or singularly bad housing conditions. In addition the boundary line did not have to be too far away from the centre because the success of the experiment depended upon regular attendance by a large proportion of the total membership, and this could not be obtained unless all member families were within easy walking distance.

Although the Peckham scientists were to a certain extent fighting commercialism in the form of entertainment, they could not deviate sufficiently from the normal procedure to employ commercial advertising methods proper. However, they did issue circulars to the residents of the district, containing details of, and reasons for, membership together with some of the facilities offered. But it was necessary for the centre to insist upon spontaneous action, so they could not allow themselves to do more than state the facts in the most unemotional terms.

After overcoming a lot of difficulties, the problem of collecting families was solved. A fairly representative cross-section was also obtained. Below is an approximate class analysis of a sample of 500 individuals.

		per cent.
In *permanent* employment (Civil servants, busmen, small traders, etc.) ...	201	40·2
In *regular* employment (Factory workers) ...	240	48·0
In *casual* employment (Often seasonal) ...	37	7·4
Small pensioners ...	22	4·4
	500	100·0

Unfortunately since it was not possible to select families at will, the above does not comprise an entirely representative population. This affects the statistical results. Although it does not mean that statistics collected by the centre are unreliable, it does mean that they cannot be widely applied without making certain reservations.

The purpose of the centre has been mentioned, the difficulties associated with its early development, and the importance of the part played by the individual member, but little has been said about the facilities offered to members.

This building has a swimming pool, with a smaller one for children, a large and well-equipped gymnasium, a cafeteria licensed to sell intoxicants, billiards, dance floor, library, theatre, playrooms and playgrounds for children. The compulsory health overhaul is also a great advantage to the member. All this is offered to the people of Peckham at the rate of 1s. per week per family on a subscription basis. Since the war this has been increased to 2s. A small nominal charge, to adults only, is made for the use of all equipment, and entertainment that is organized by groups of members, such as a play produced by the drama group.

A reference was made to the importance of environment when assessing man's functional ability. Since this is a very much misused word, it is perhaps worth probing a little more deeply into the abstract term "environment."

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It is interesting to note that some sciences seek a stable environment in which to conduct their experiments—for example physics; whilst some require a natural one—such as biology. For the physicist, any environmental change in light or heat would falsify his results. In the Peckham centre a natural environment is preserved as far as possible, since a normal person in natural surroundings must be taken as the criterion. If this were not so, any conclusions reached in the course of investigations could not be generally applied.

In the centre itself we can perceive four major environmental elements, which will interact one upon another.

(*a*) The Peckham scientists with their staff.

(*b*) The actual centre with its equipment.

(*c*) The incoming members of the most diverse kinds.

(*d*) Freedom of action throughout the centre for all members.

The centre and its equipment will provide opportunities and facilities for physical and functional health for the members who will be further influenced by knowledge received from the scientists, this in turn provides the raw material from which is drawn the data for observation.

After effecting the fusion of these elements, what are the results? Although it is not possible to mention all of them, one can arrive at a number of conclusions after even a superficial examination.

After a visit to the centre, one realizes that it does produce a definite mental state. In spite of the fact that modern man is now free from restrictions imposed by climatic and limiting conditions in general, there are still obstacles preventing his complete bodily and mental emancipation. Average, everyday life proves to us that in its present form it tends to build up all kinds of unnatural resistances. The life of the centre goes a long way to breaking down these resistances within oneself. Here there is a genuine sense of ownership with each individual member. As a result of the knowledge presented to them they also have a consciousness of purpose.

Here, in the centre, the members have their co-ordinating factor or common basis. The main difficulty in establishing contact with people moving in different spheres, lies in the absence of a common basis of experience. Thus, in these days when two people meet they seek in their conversational opening for that common basis. For example it is a well-known joke that the English always talk about the weather.

Much has been mentioned concerning the periodical health overhaul, which takes place about once every eighteen months. It will be profitable to examine at this juncture, this particular feature of the centre. The overhaul is an attempt to estimate the physical capacity for: (*a*) individual life; (*b*) family life; (*c*) social life.

This involves a laboratory examination which reveals a tremendous amount of factual knowledge, such as the number of red and white blood corpuscles one has, and measures the blood's iron content and so on. Then there is the more usual type of examination which determines one's height, weight, vision, build, type and soundness or otherwise of the body's component parts.

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All this information is then collected and recorded in the form of a case-history for each person. No item of information is missed, however small.

When the process of collection is complete, the family as a whole have a consultation with the doctors and biologists who carried out the individual examinations. This consultation is quite informal and any sign of the normal surgery atmosphere is dispelled. The results of the examinations are presented to the family, starting with the youngest member and finishing with the father, in non-technical language. The family then try to give to the scientists any additional information that will enable them to arrive at a more intelligent interpretation of the mass of facts. Then follow any questions or comments either wish to make.

To realize the full value of these unorthodox methods, one only need analyse the advantages the centre doctor has over the ordinary practitioner.

(*a*) He sees the patient regularly. Usually the sufferer will not approach his doctor until suffering from a major rather than a minor malady.

(*b*) He has a well-equipped laboratory at his disposal.

(*c*) He is in a much better position to effect cure since he sees and is familiar with the whole family.

At certain intervals a survey is carried out to ascertain exactly what are the net results of examinations of the member families. From one such survey, certain facts emerge that are of general interest.

The first, and most outstanding, finding is that from a total of 3,911 individuals examined, 90·85 per cent were found to have some disorder. Considering that this district, by virtue of its setting, is more likely to yield a relatively healthy populace than many others, this fact is a disturbing one. It indicates that although our knowledge of medical science is greater than ever before, this knowledge is not being applied as effectively as possible.

After examining the 90 per cent with disorder, it was found that from the clinical aspect they did not present any new problem, since all the disorders were those already known. Viewed from the health angle, classifying these disorders gave rise to an interesting problem. It was thought necessary to classify them in two ways. The first method was to classify them from the clinical aspect. The second classification was arrived at according to the reaction of the individual to his or her condition. Classified from this subjective point of view, they fall into three categories.

A. Those in whom disorder is accompanied by organic disease.

B. Those in whom disorder is associated with a sense of well-being.

C. Those without any sign of disorder.[1]

The first category represents about 25 per cent of the total. To appreciate the implications of this figure it must be realized that quite a number of these people were suffering from a major disease and were not seeking treatment for it. Since 75 per cent of the total disordered pass into the last two categories mentioned, it shows that a person can have a serious disease a considerable period of time before it makes its presence felt, and suggests that much of the high

[1]The Hypotonic is in exactly the hypothetical position of a person with no apparent signs of pathological disorder, yet with no sign of positive health.

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chronicity rate of certain diseases is due to deficiencies in the administration of our medical services. If the methods employed by the centre were widely applied, with certain modifications, which would be obviously essential, this should tend to increase the general standard of health.

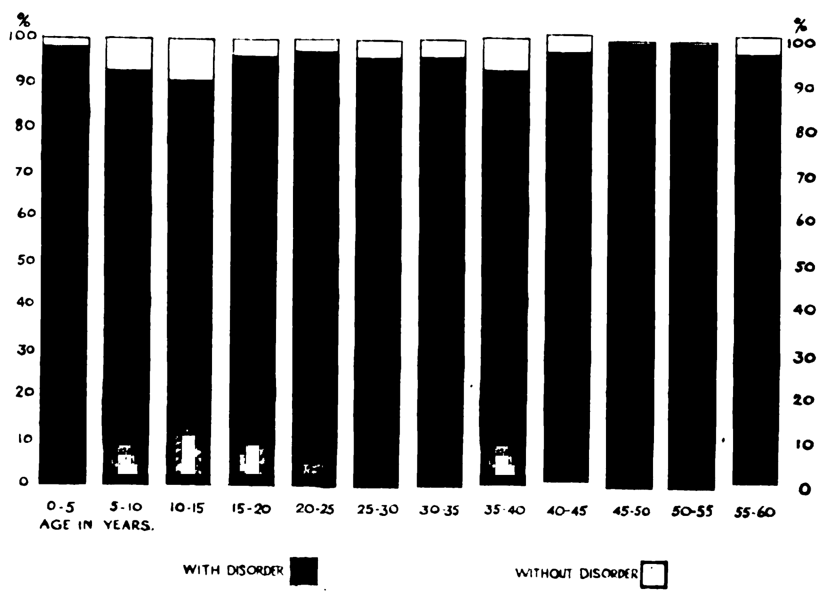
After reviews at two different periods, the relative proportions in disease, in well-being or without disorder were found to be very much the same, as shown below. This indicates quite clearly that the high disorder rate cited for the first survey was not of unusual proportions.

Category	1st 500 *families*	*Per cent.*	2nd 500 *families*	*Per cent.*
A.—Organic disease ..	484	31·6	328	21·3
B.—Well-being	902	59·0	1,052	68·5
C.—Without disorder ..	144	9·4	156	10·2
	1,530	100·0	1,536	100·0

In conclusion, the effect of the work completed in the comparatively short life of the centre, can be briefly summarized. Wide fields of research hitherto unexplored have been opened and await further investigation. It provides unparalleled opportunities for research into the physical constitution of man. The problem of clinical disease is for the first time seen at the period of its departure from health. The particular structure of the centre permits of close investigation into the socio-biology of the family unit and its environmental associations.

The writer wishes to express his thanks to Dr. Innes H. Pearce, Co-Medical Director of the Pioneer Health Centre, for helpful comments while preparing this article and for permission to forward it for publication.

COMPARISON OF DISORDER RATE AMONG CERTAIN AGE-GROUPS FEMALES



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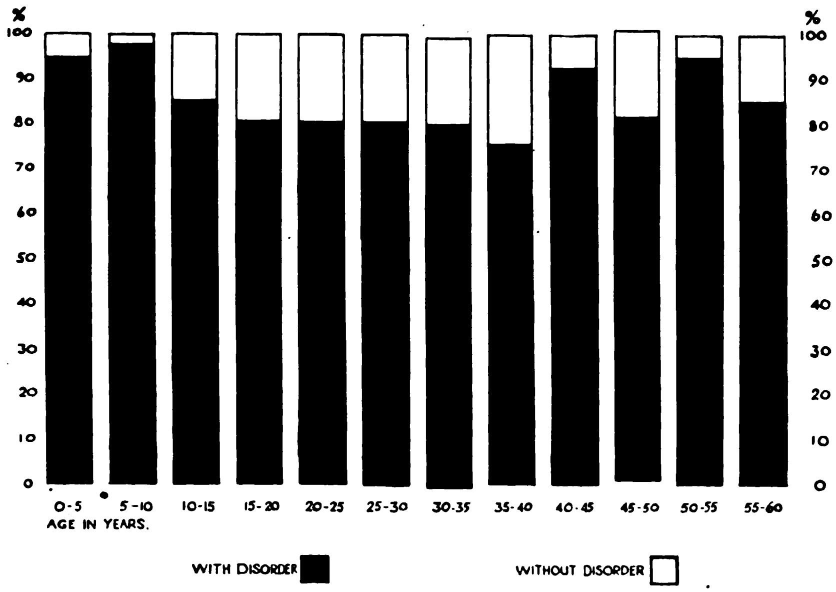
COMPARISON OF DISORDER RATE AMONG CERTAIN AGE-GROUPS MALE



The two histograms, being derived from a different set of figures, do not correspond exactly to the Table given in the text.

A CASE OF MENINGOCOCCAL SEPTICÆMIA

BY

Lieutenant-Colonel JOHN MACKAY-DICK, M.B., Ch.B., F.R.C.P.Edin.
Royal Army Medical Corps.

ONE evening about midnight a coloured member of the East African Pioneer Corps in his early twenties was admitted to a British Military Hospital in Haifa in 1943. He was in coma, breathing was stertorous, there was neck rigidity, head retracton and Kernig's sign, Brudzinski's sign and Brudzinski's identical contralateral index were present as were other signs found in meningitis. He was febrile, T. 104°F. There was no vomiting and no incontinence of fæces or urine. The spleen and liver were not felt. There were numerous crepitations in both lungs. Petechiæ were not noted but it is unlikely that they would have been observed had they been present in his jet black skin. There was no urethral discharge.

Three days previously the patient had been discharged from another military hospital where he had intermittent pyrexia for which no obvious cause had been demonstrated. He had been regarded as a case for "Malaria Clinical" and given the routine course of anti-malarial treatment obtaining at that time (quinine-mepacrine-pamaquin) with apparently the desired therapeutic result.

On admission our immediate routine investigations in such cases were commenced; these included urine examination, B.P., a total and differential white blood cell count, thick-drops and blood-films examined for malarial parasites, etc., and a lumbar

puncture with the following results: W.B.C. 20,000/c.mm with marked polymorphonuclear leucocytosis.

Much to our great surprise the stained blood film showed large numbers of extracellular and intracellular diplococci which were meningococci.

No malarial parasites were to be seen.

Lumbar puncture revealed milky cerebrospinal fluid under marked pressure and which showed the typical findings of a purulent meningitis with large numbers of diplococci which were meningococci.

The diagnosis was obviously a meningococcal septicæmia with meningitis. The patient was placed on the D.I.L. 0·3 gramme sulphadiazine were given I.V. and repeated six-hourly. A slow continuous I.V. drip of 5 per cent. glucose saline was set up and 4 per cent. sod. citrate added. Hopes of recovery were at a low ebb but about nine hours after admission the patient was sitting up in bed, rational, with an expansive grin all over his face, the I.V. drip in position and working well and of all things he was smoking a cigarette. He made an uninterrupted recovery with the passage of time. However, for the sake of completeness an X-ray of the chest revealed an area of consolidation in one lung and meningococci were found in his sputum.

It is regretted that blood was not taken for a blood culture although the presence of the numerous meningococci in the blood-film was ample evidence of a blood-stream infection.

Comment.—It is not unlikely that such a remarkable case as this might well have developed the Waterhouse-Friederichsen syndrome. The rapid recovery of the patient under the therapy adopted demands the repeated assurance that the patient's condition was as described on admission and that he was not just asleep!

The fact that he had been previously diagnosed, and treated, as a case of clinical malaria because of intermittent pyrexia without the demonstration of malarial parasites would suggest that all along he was a case of meningococcal septicæmia—it being well known now that intermittent pyrexia similar to that found in the established case of B.T. Malaria is not infrequent in cases of meningococcal septicæmia. Major-General Priest amongst others has drawn attention to that fact.

The word "septicæmia" used to convey to many a very ill febrile patient, but experience shows that in septicæmia any type and degree of pyrexia may be found and in numerous cases of low-grade irregular pyrexia with a patient in just vague ill-health it is not uncommon to find that septicæmia has never been considered "because the patient is not ill enough." This habit of excluding diseases on the severity or otherwise of signs and symptoms cannot be too strongly condemned. *It is so typical of confidence in the inexperienced.*

I well remember a young nurse in her early twenties with prolonged irregular pyrexia who was regarded as "neurotic" and suspected of faking her temperature just because the cause of her long-drawn-out irregular pyrexia could not be demonstrated. I need scarcely add that a septicæmia had never even been considered in her case, yet her appendix had been removed as a possible cause of the febrile illness but without benefit. It transpired that several months previously she had recurring bouts of extensive furunculosis. This finally disappeared, but for months afterwards she felt easily tired, sweated a great deal and whilst on duty at nights she found that her temperature was elevated. Low-grade ill-health continued resulting in her reporting sick. Repeated blood

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cultures were subsequently negative but our facilities were not very good. The presumptive diagnosis of staphylococcal septicæmia was made in this case with a total W.B.C. count of 10,000/c.mm. An adequate course of penicillin I.M. was prescribed. She made an uninterrupted recovery and was given a month's sick leave after an adequate spell in hospital. Some time later she was married and she continued in excellent health.

Pitfalls to the unwary in febrile illnesses are staphylococcal and meningococcal septicæmias in which the total white blood cell count may be anything between 4,000/c.mm. to 10,000/c.mm. for quite a long time and where the differential white blood cell count may show at the most a mild polymorphonuclear leucocytosis. With such blood-counts in cases of low-grade irregular pyrexia the enteric group fevers must never be forgotten. It should be more and more realized and emphasized that so-called typical clinical pictures of infectious disease should be diagnosed without difficulty but that it is the so-called atypical cases, i.e. the cases that do not follow typically the textbook description that are usually missed and are therefore a great danger because of the part that they can play in the further spread of the disease—these so-called atypical cases are not as infrequent as some would have us believe.

In the diagnosis of febrile illnesses the ability to think of likely and not unlikely causes at one and the same time as well as the institution of a relevant routine drill to exclude likely and not unlikely causes should be set in motion as rapidly as is relevant. At the same time the medical practitioner should ignore any tendency on his part to exclude diseases on purely clinical grounds alone—on the lack of severity, presence or absence of some sign(s) or symptom(s)—experience shows that to do so is to court disaster. However, such a broad approach to the diagnosis of febrile cases comes from experience—the best teacher of all.

I present this case for publication because of (1) its particular severity and the profound and generalized nature of this infection, (2) the rapid and dramatic response to the therapy adopted and, (3) the fact that previously a diagnosis of malaria clinical—on occasion a dangerous diagnosis to make except in an emergency—had been made and treatment given accordingly when in all probability the diagnosis was really meningococcal septicæmia. This latter diagnosis should never be forgotten in all cases of intermittent pyrexia especially in ex-tropical patients, and in the tropics or subtropics or wherever malaria may be suspected, when repeated attempts to demonstrate malarial parasites in thick-drops and blood-films, and even after sternal puncture, have failed, although sternal puncture in such cases is not recommended as a routine except in the hands of an expert.

In conclusion, the multiplicity of manifestations and the varying degrees of severity of febrile diseases are stressed and the need for a broad approach to diagnosis, with a true sense of humility as regards the limitations of purely clinical findings re diagnosis and the prime importance of having a "DRILL" as regards the carrying out, and repetition, of all relevant tests at the earliest and appropriate times in cases of pyrexia of doubtful origin, is emphasized.

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ACKNOWLEDGMENTS

Major-General Sir Edward Phillips, *K.B.E., C.B., D.S.O., M.C.*, D.M.S. British Army of the Rhine, for permission to forward these notes for publication. Major B. Portnoy, R.A.M.C., for the laboratory investigations and Captain A. A. Gattas, R.A.M.C., for his assistance with the case.

ARMY MEDICAL DEPARTMENT NOTES

(1) HEALTH CONFERENCE

A.D.H. attended the Royal Sanitary Institute Health Congress at Harrogate from May 24 to 28.

The Right Hon. Lord Inman of Knaresborough, P.C., J.P., presided and there was a very large and representative gathering including delegates from almost every country except the U.S.S.R. and Eastern Europe.

Interesting and instructive papers followed by discussions were read at the various conferences and much useful information was obtained.

A new film on Infantile Paralysis (Poliomyelitis) produced by the Ministry of Health was well received by a very large audience and it was stated by Dr. Bradley that this would be available for circulation in about six weeks or two months. The film lays emphasis on early diagnosis, notification and treatment and also deals with the rehabilitation aspect. It should be of assistance to all medical officers who should be given an opportunity of seeing it at an early date.

(2) ADJOURNMENT DEBATE

An adjournment debate upon the suicide of Pte. Robson was held in the House of Commons on Wednesday, April 28. The question of the retention in the Army of men showing signs of instability was raised and the suicide Pte. Robson instanced as one of the possible results of retention of men whose stability can reasonably be doubted on psychiatric grounds. In replying the U.S. of S. fully vindicated the medical care and supervision which this particular man had received. But the incident and the debate have brought to light the reluctance in some quarters to accept the results of psychiatric examination when these issue in a recommendation for discharge. Psychiatrists are accused of helping men to evade service and of accepting at face value tales told to this end. The younger psychiatrists are tempted to yield to such pressure, in spite of clear psychiatric indications, when it is brought to bear by senior officers. Though this attitude does not often end so drastically as in the case of Pte. Robson it has a persistently deleterious effect upon the morale of the Army by retaining men whom form foci of low morale.

(3) THE UNVEILING OF THE MEMORIAL PLAQUE THE ROYAL MASONIC HOSPITAL

On the afternoon of Thursday, June 10, 1948, The Rt. Honourable Emmanuel Shinwell, M.P., The Secretary of State for War, unveiled the commemorative

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plaque, which, together with a Megatherm Diathermy apparatus, was gifted to the Royal Masonic Hospital by the three fighting services as a token of their appreciation for what was done for them by this Hospital during World War II.

During the period 1939–46, 8,641 members of the allied fighting services were treated in this hospital, the cost of whose treatment and maintenance while in this hospital was borne, completely, by the Brotherhood of Freemasonry.

The Army Medical Services were represented by:

Lieut.-General N. Cantlie, D.G.A.M.S.
Dame Louisa Wilkinson, Matron-in-Chief.
Brigadier D. Fettes, Consulting Surgeon.
Brigadier J. Bennet, Consulting Physician.
Brigadier R. D. Cameron, D.D.M.S. London District.
Lieut.-Colonel J. C. Barnetson, A.D.G.A.M.S.

After the Ceremony a most excellent tea was provided, to the strains of a string orchestra, in the pleasant surroundings of the Nurses Home.

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Notice

BOOKS FOR STAFF COLLEGE

THE shortage of reference books for officers studying for the Staff College is serious.

A detailed investigation of Command Libraries reveals that the number of copies of each of the books recommended in ACI 323/47 seldom exceeds 4 in each Library and is usually less, particularly in overseas commands.

This is quite inadequate when it is realized that over 700 officers took the exam. last February and that even more are expected to sit in 1949.

It has proved impossible to increase these stocks since the majority of the books are out of print and no date for reprinting can be given.

It is considered, however, that there must be large numbers of these books in private ownership and an effort is being made to acquire all available copies.

Would any officers having copies of the undermentioned books, not now required by them, be so kind as to forward them to War Office AE5.

Publisher	*Author*	*Title*
Constable	Wavell	The Palestine Campaign
Constable	Massey	The Desert Campaign
Inst. of RE	Bowman-Manifold	The Outline of the Egyptian and Palestine Campaign
Harrap	Wavell	Allenby, Soldier and Statesman
Country Life	William-Ellis	The Tank Corps
Angus and Robertson (Sydney)	Monash	The Australian Victories in France
Hodder and Stoughton	Montgomery-Massingberd	The Story of the Fourth Army
Constable	Dewar and Boraston (ed.)	Haig's Despatches: Dec. 1915 to Apr. 1919
Hutchinson	Montgomery	El Alamein to the Sangro
Hodder and Stoughton	De Guingand	Operation "Victory"
H. Hamilton	Moorhead	African Trilogy
Hutchinson	Montgomery	Normandy to the Baltic
Secker and Warburg	Shulman	Defeat in the West
Service Inst. Collins	Fergusson	Beyond the Chindwin
Service Inst. Collins	Fergusson	The Wild Green Earth
Private	Leese	Brief History of the Operations in Burma
Macmillan	Edmonds	History of the Great War—1914. France and Belgium. Volumes I and II
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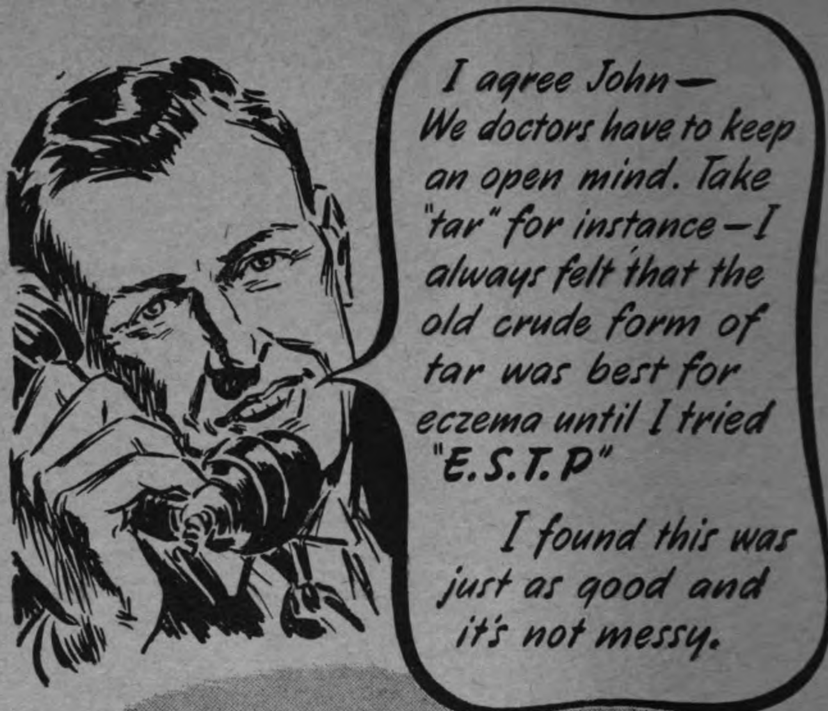

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FORWARD PSYCHIATRY

ADDRESS DELIVERED BY

Lieutenant-General (then Major-General) N. CANTLIE, *C.B., M.C.*

WHEN D.D.M.S. EASTERN COMMAND, INDIA, TO A CONFERENCE ON PSYCHIATRY, AUGUST 8, 1944

MAJOR-GENERAL CANTLIE, said that he was very pleased indeed to open this conference of psychiatrists. He complimented Brigadier Bennet on the comprehensive organization which had been built up in the short time of less than two years. Of special importance was the scheme for the forward treatment of acute psychiatric casualties, occurring during the course of battle. By tackling these cases at an early stage in their illness, before it had the chance of developing into a resistant and chronic structure, psychiatrists had made a valuable contribution towards the saving of man-power and towards lightening the burden of hospitals in the rear. From being a bit of a sceptic to start with in the earliest days of the war that psychiatrists with fixed formations might prove a wrong policy, he had been converted, by actual experience, into full belief.

A word of warning was necessary to psychiatrists, the majority of whom in wartime had come straight from civilian practice to take psychiatric duties in the Army. In civilian practice they were dealing with patients for whom, in the main, illness was a disadvantage because of the consequent loss of earning power or of opportunities for advancement in their careers. In the Army, conditions of life for the individual were very different. In wartime the Army was comprised largely of men conscripted from civilian life. Collectively they were imbued with the wish that all their energies should be directed towards attaining final victory over the enemy. In their ranks, nevertheless, were men who, by reason of deficiency or abnormality in their make-up, were incapable of fitting smoothly as cogs in the military machine. There were also, without doubt, those who realized that the proffering of some degree of unsuitability would perhaps reduce their chances of being selected

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for certain dangerous duties, and who therefore exaggerated, or made little effort to overcome, quite normal fear reactions to the threat of danger. Some could even be considered guilty of not trying to overcome the slight stress inevitable in the switchover from a life of their own choosing, under peacetime conditions, to the more strictly directed life of a soldier.

The need for Army experience in dealing with the soldiers was emphasized. Psychiatrists must be on the alert for the malingerer, and it was important that the report of the soldier's C.O. and Coy. Officer should be obtained as well as that of the R.M.O. It was in distinguishing these two very broad groups (the defective or abnormal and the malingerer) that a great responsibility rested with the psychiatrist. To equip himself for this task he should have an intimate knowledge of the soldier and how he lived during his training period and under conditions of active service.

When a psychiatrist was first posted to his Corps in North Africa, General Cantlie told him that he was the most unwanted man in the corps. The G.O.C. was afraid that, now he had a psychiatrist, discipline in the Corps would be ruined. A man who was under arrest for some breach of discipline, it was thought, had only to see the psychiatrist, tell a tale of his mother being frightened before he was born, or some such plausible tale, and he would be let off any punishment. The G.O.C. said the psychiatrist would be judged by results, and if the results, as regards discipline, were poor, the psychiatrist would get the sack. It can now be said that these early fears were groundless. The psychiatrist soon proved his worth.

The first essential was that the psychiatrist must go into action and see the stress and strain of battle. He must see troops tired from lack of sleep, hungry and thirsty, deafened by the noise of battle, and he must experience all this from the R.A.P. level and in front of it. His psychiatrist in North Africa was very keen to have the chance, and did take part in an attack shortly afterwards. It is essential that the psychiatrist should have actual experience of the field of battle.

Psychiatry at the divisional level in battle was relatively simple, and General Cantlie said that he acted as a stop-gap psychiatrist himself when the Corps psychiatrist was not available. No doubt mistakes were made, and some sent back to duty ultimately broke down again.

Speaking broadly, cases fell into three groups. First, these acute conditions, where fatigue, fear, lack of sufficient sleep, water and food, had overcome the normal resilience of the human mind. These cases were classed under the label "Exhaustion." In this group the psychiatrist had to distinguish men in whom there was a conscious wish not to return to the battlefield. It was looking for trouble to let such cases slip through to the rear. The remainder responded quickly to rest, sleep, food and reassurance.

Secondly, a group consisting of dullards and those of an inherent mental instability. Often men of this type made a good endeavour to carry on in the battle but their native mental equipment was just not good enough for the job in hand. Psychiatrists could do much good work here in assessing

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what assets such men did possess, and in making recommendations for their employment in some job within their capacity.

Thirdly, there was the group of truly psychotic cases, the genesis of whose illness was constitutional and related, only coincidentally, to the fighting in which they had been participating. With these, only the question of disposal arose.

The role of the psychiatrist in the field, was that of the adviser to the D.D.M.S. or A.D.M.S. Every administrative decision on psychiatric matters had to be made by the A.D.M.S. or D.D.M.S. He might seek the psychiatrist's advice, but must make his own final decision in the light of all relevant circumstances.

It was important to know the medical officers of the units under one's Command to evaluate correctly the information received from them. An instance was quoted of a regimental medical officer from whose unit numerous "exhaustion" cases had been received and whose interest in psychiatry was marked—too marked—and who later was himself evacuated as a psychiatric casualty.

The R.M.O. who dabbles in psychiatry on the wrong lines, and without adequate experience, is a danger to a unit, and should be removed.

In conclusion, General Cantlie stated that it would be the goal of every psychiatrist to fit men for their jobs, rather than to evacuate them when they break down.

The future will lie more, he hoped, in preventing breakdown under the hideous din of war. The psychiatrist should give advice to Commanders on various aspects of battle, such as the importance of overcoming administrative difficulties so that men went into battle well fed, and all similar matters bearing on unit morale. Instructions to R.M.O.s on the correct use of sedatives and stimulants was also the responsibility of the psychiatrist.

Psychiatrists in forward areas working along these lines, could make an important contribution to the prophylaxis of psychiatric illnesses.

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THE EFFECTS OF MAPHARSIDE ON THE WHITE CELL COUNT OF EARLY SYPHILIS

BY

Lieutenant-Colonel (Hon.) R. R. WILLCOX, M.B., B.S.

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NEUTROPENIA, following the use of arsphenamines, is a well-recognized condition and, apart from infective or idiopathic causes and exposure to X-rays and other radio-active substances, such an event may follow the administration of other drugs as amidopyrine, barbiturates, dinitrophenol, sulphonamides, thiouracil and the heavy metals, to name but a few. It is with this complication in mind that white cell counts are regularly performed as a routine in any antisyphilitic schedule involving intensive rather than long-term methods of treatment with organic arsenical compounds.

The white cell counts of 405 adult male cases of early syphilis have already been studied [1]. These showed no startling distinctions between seronegative primary, seropositive primary and secondary syphilis apart only from a very slight tendency to a lymphocytosis and perhaps a minimal increase in the large mononuclears as the disease progresses. These 405 cases comprised 166 patients with seronegative primary syphilis, 164 with seropositive primary syphilis and 75 with secondary syphilis and the object of this paper is to show how the white cell counts of these patients reacted to a regime consisting of ten daily intravenous injections of 0·06 gramme of mapharside. Commercial penicillin in doses of 40,000 units, injected intramuscularly every three hours to a total of 2·4 million units, was given concurrently.

The initial blood-counts were usually performed within twenty-four hours of admission, often a few hours after penicillin therapy had begun but before any arsenical compound had been administered. In uncomplicated cases the counts were repeated on the fourth to fifth and the eighth to ninth days. These will be referred to as the second and third counts respectively. All examinations were performed to a standard method and vital staining was not employed.

Under treatment the third counts, like the first, were practically indistinguishable as to the type of disease present, though the second count showed some lag in respect of seropositive primary syphilis which had, however, quite evened out in the third and final count.

THE TOTAL WHITE CELL COUNT

The average number of white cells per c.mm. in the first count was 8,950, the second 8,190 and the third 7,620. Thus there was an overall drop of 14·9 per cent, which was caused mainly by a fall in the neutrophil polymorpho-

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nuclears though there was also a decrease in the other elements. The same tendency was noticed in whatever manner the cases were grouped, though certain individual counts, especially in the lower ranges, actually increased while under treatment. The blood-count is well known to fluctuate under normal conditions. These cases were therefore at the lower levels of normal at the time the first count was performed and had ascended to, or towards, the higher levels at the time the subsequent observations were made.

POLYMORPHONUCLEAR NEUTROPHILS

	Absolute	*Percentage*
First count ..	5,560	62
Second count ..	4,910	60
Third count ..	4,505	59

There was an overall drop of 19 per cent in the absolute polymorph count which was reflected to a lesser degree in the percentage calculation. This fall is also manifest if the figures are arranged to show the proportions of the absolute counts falling in the different ranges.

	First count Percentage of counts	*Third count Percentage of counts*
Above 9,000 ..	4	1
7,000-9,000 ..	22	12
4,000-6,000 ..	62	57
Below 4,000 ..	12	30
	100	100

LYMPHOCYTES

	Absolute	*Percentage*
First count ..	2,830	31·5
Second count ..	2,740	33·5
Third count ..	2,590	34·0

There was thus a smaller, but none the less present, decrease in the absolute lymphocyte count amounting to 8·5 per cent. The proportionately greater fall in the numbers of polymorphonuclear neutrophils, however, makes this appear as a small increase in the relative percentage. This decrease is also shown in the table depicting the proportions of the absolute lymphocyte counts falling in the different ranges.

	First count Percentage of counts	*Second count Percentage of counts*
3,500 and above ..	26	18
2,000-3,000	67	71
1,500 and below ..	7	11
	100	100

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Large Mononuclears

		Absolute	Percentage
First count	..	410	4·5
Second count	..	390	4·5
Third count	..	375	5·0

A similar state of affairs is shown in the reaction of the large mononuclears. There was a fall of 8·5 per cent in the absolute numbers, though the drop in the other elements made it appear as an increase in the percentage counts. For example, the proportion of the counts in which the mononuclears reached, or exceeded 7·5 per cent was 8·4 per cent for the first count, 11·9 per cent for the second, and 12·6 per cent for the third count.

Eosinophils

The same tendency, though less marked, was evidenced in the case of the eosinophil cells, the absolute totals for the three counts averaging 125, 120 and 120 respectively and the percentages all being in the region of 1·5 per cent. Owing to the greater fall in the numbers of the other types of cell, there was a progressive increase of the proportion showing a percentage eosinophil count of 2·5 per cent or over. This was 16 per cent for the first count, 18·6 per cent for the second and 25·4 per cent for the third count.

Basophils

The basophils seemed to be the only component which actually showed some, if small, signs of increase while under treatment, though the average absolute counts compared only at 25, 30 and 30 and this increase was within the limits of experimental error. There was, however, a noticeable drop in the proportion of the counts showing zero basophils and an increase in the number showing a percentage of basophils greater than 0·5 per cent.

		Percentage of zero counts	*Percentage exceeding 0·5 per cent*
First count	..	54·3	6·7
Third count	..	43·6	10·0

Leucopenia

It was customary definitely to discontinue treatment with mapharside, and increase the penicillin, if the total white count fell to 4,000, or the polymorphonuclear neutrophil count to 40 per cent. Total counts of below 5,000 and polymorphonuclear counts below 50 per cent were very suspect and treatment usually modified.

14 of the 166 seronegative primaries, 8 of the 164 seropositive primaries and 8 of the 75 secondary cases had their treatment with mapharside suspended or modified on this account. 12 of these cases arose during the first four days and 18 after this time. The initial blood counts of this series were drawn generally from the lower total white count ranges, though this was by no means always the case. The average first counts were thus lower than

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average, possessed markedly fewer polymorphs and showed a higher percentage of lymphocytes than the average for the whole, viz.:

	Absolute	*Percentage*
Polymorphonuclear neutrophils ..	4,060	57·0
Lymphocytes	2,600	36·5
Large mononuclears	350	5·0
Eosinophils	65	1·0
Basophils	25	0·5
Total	7,100	100·0

Herxheimer Reactions

27 seronegative primaries, 30 seropositive primaries and 13 secondary cases showed a Herxheimer effect with primary fever. There was thus no significant difference in the incidence of this reaction according to how long the patient had had syphilis. The initial counts showed no marked differences from the normal and the third counts too, regarding the total count, were a good sample of the average though there was a greater tendency to lymphocytosis (36 to 38 per cent). Treatment was not suspended in these cases though the mapharside was usually withheld for twenty-four to forty-eight hours until the temperature had returned to normal.

Secondary Fever

While under treatment, 14 of the seronegative primaries, 19 of the seropositive primaries and 11 secondary cases showed a secondary pyrexia as a major symptom, and the treatment was altered accordingly. These patients showed a higher initial count (9,800) but they dropped 14·7 per cent as compared with 14·9 per cent for the whole and were thus apparently only geared at a higher level.

Dermatological Complications

Only 9 cases exhibited cutaneous reactions. The number is too small for strict comparison, though the average of the initial counts was similar to the average of the whole as regards the total number of cells, though there was a slight lymphocytosis (37 per cent). Under treatment the total counts dropped no less than 26 per cent to 6,400, the differential remaining unaltered except for an increase in the percentage of large mononuclears from 3·5 to 5 per cent.

Arsenical Encephalopathy

This was fortunately a rare complication. There was one established case and two others each had an epileptic fit, one after seven injections and the other at the termination of treatment. The latter case also showed vomiting, headache and a temperature of 99° F. and was thought to be a mild case of arsenical encephalopathy. The other case, showing headache and a temperature of 98·8° F., had had such fits before and was considered as doubtful. The mild case, suffering from seronegative primary syphilis, was treated

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with B.A.L. He had an initial total white cell count of 9,000 which had fallen to 5,700. The doubtful case, a patient with secondary syphilis, had an initial total white count of 5,800. He received no specific treatment, apart from discontinuance of the mapharside, and the white cell count in this case fell to 4,100 with a polymorphonuclear neutrophil percentage of 36 per cent.

The severe case arose in a man with late secondary syphilis after only four injections of the drug. He exhibited slight fever, headache, photophobia, extreme lethargy and inability to respond to the spoken voice or other external stimuli, associated with a markedly raised protein in the cerebrospinal fluid. He was never unconscious and had no epileptiform seizures. He received B.A.L. and made a steady, if slow, recovery. The initial white cell count in this case was 14,500 which fell in three days to 5,100.

Thus in all these three cases the fall in the blood-count was more accentuated than that of the average for the whole.

SUMMARY

The white cell counts of 405 cases of early syphilis treated with ten daily injections of 0·06 gramme mapharside combined with penicillin have been studied. There were no significant differences in the responses of seronegative primary, seropositive primary and secondary syphilis.

There was a general fall in the total count amounting to approximately 15 per cent. This decrease was most noticeable in respect of the neutrophil polymorphonuclear cells but was also present in the case of the lymphocytes and large mononuclears. The eosinophils remained about stationary but the basophils appeared slightly to increase.

Owing to the larger fall in the neutrophil polymorphonuclears there was a relative increase in all the other elements.

Cases showing leucopenia necessitating modification of treatment had lower initial counts, those showing Herxheimer reactions had average and those showing secondary pyrexia had somewhat higher initial counts than the average for the whole.

A very marked drop was noticed in the white cell count of patients manifesting dermatological complications and also in those who suffered from arsenical encephalopathy.

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THE BURMA CAMPAIGNS—1942-1945.
A HISTORY OF CASUALTY EVACUATION

BY

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ABBREVIATIONS USED IN THE TEXT

M.D.S...	..	Main Dressing Station (of Field Ambulance).
I.S.S. ..	..	Indian Staging Section.
C.C.S. ..	..	Casualty Clearing Station.
I.M.F.T.U.	..	Indian Malaria Forward Treatment Unit.
I.G.H.	..	Indian General Hospital.
F.T.U...	..	Field Transfusion Unit.
I.S.D.M.S.	..	Indian Sub Depot Medical Stores.
M.S.U...	..	Mobile Surgical Unit.
M.A.S...	..	Motor Ambulance Section (approx. 33 vehicles).
E.A.M.A.C.	..	East African Motor Ambulance Convoy (approx. 75 vehicles).
L.C.M...	..	Landing Craft.
L.C.T. ..	..	Landing Craft.
L.C.I. (D)	..	Landing Craft Infantry (Depot Ship).
E.T.A...	..	Expected Time of Arrival.

INTRODUCTION

THE object of this article is to give a brief historical account of the evacuation of casualties during the campaigns in Burma from 1942 to 1945. The fighting in this Far Eastern theatre was unique in many ways. In variety, from the mountain warfare of Eastern Assam, the open warfare of the Central Burmese Plain, the combined operations along the coast of Burma, to the long drawn out fatiguing and hitherto unexperienced type of fighting in tropical jungle. It saw the development of air evacuation used for the first time on a large scale in modern warfare, a whole army being entirely dependent upon the evacuation by air of all its sick and wounded. Finally, in the type of country and the distances involved it was again unique, the front from Northern Burma and Assam to the Arakan being longer than the Russian front in Europe.

Another important feature of the campaigns was that the Supreme Commander, Lord Louis Mountbatten, was able to plan the reconquest of Burma over the "impossible" land routes, and through one of the most unhealthy belts of country in the world, knowing that his medical services were so much superior to those of the enemy and that his air forces could supply the troops and evacuate all their sick and wounded.

General Sir William Slim, Commander-in-Chief of the 14th Army, has commented on the reduction of sickness in the Imperial Forces in S.E. Asia, from the calamitous figure of eight per thousand per day in 1942 to less than one per thousand per day in 1945—a rate which would be considered reasonable in a large industrial undertaking in this country.

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In the evacuation of casualties, the most notable advances were made in speed of evacuation, especially of the urgently sick and wounded. The time period for evacuation to Base Hospitals fell from weeks in 1942 to days in 1943 and finally to hours in 1944 and 1945. This was achieved at the same time as the Army was advancing into Burma and lengthening its Lines of Communication, and was largely the result of increasing use of air evacuation and the selective evacuation of the more serious and urgent patients.

PHASE ONE

THE RETREAT FROM BURMA—1942

The Japanese forces invaded Southern Burma in the early weeks of 1942. The invasion followed their occupation of French Indo-China and Siam, and their rapid conquest of Malaya. The 17th Indian Division formed a defence line on the Salween river to stem their advance but after severe fighting the Japanese succeeded in breaking through and the evacuation of Southern Burma became necessary. From the fighting line casualties were evacuated by ambulance train and ambulance car to Prome. Limited hospital shipping was used for the evacuation of casualties from the Rangoon hospitals to India and medical units were withdrawn along the axes of withdrawal which were the Pegu, Toungoo, Mandalay road and railway, and the valley of the Irrawaddy.

Ambulance river steamers evacuated casualties from Rangoon to Prome and later from Prome and the oil belt to Mandalay, when these areas had to be abandoned. Communications became disrupted, and organized casualty evacuation became almost impossible. Formations in retreat northwards frequently had to carry their sick with them.

Ambulance trains did invaluable work. The crews had to be armed for protection against looters, they frequently had to do their own signal and point shifting, and they were called upon to render first aid at bombed wayside stations. One train evacuated over 1,000 casualties from forward areas to Prome. They operated as far forward as the M.D.S. of the Field Ambulance on at least two occasions near the Salween river, being in great danger of being cut off by bombing of bridges. One train was derailed but was rescued and worked up to Mandalay before the Japanese overran it. Ambulance cars were machine gunned from the air, but ambulance trains seemed to have immunity from these attacks.

The first air evacuation of casualties was from Magwe, in the oil belt to India, but the numbers were small. A further evacuation by air was made from Shwebo in Central Burma when the retreat from this area became necessary. The majority of sick and wounded were, however, moved by ambulance train and ambulance steamer from the hospital areas at Maymyo and Mandalay to Myitkina in the extreme north. From Myitkina further retreat by surface routes was impossible, but sufficient aircraft were available by this time to evacuate the casualties from Myitkina to bases in north-eastern India. In ten days during April 1942 ten C.47 Dakota aircraft evacuated 1,900 sick troops and civilians to hospitals in Assam. This was the first moderately large-scale evacuation of casualties by air, and it was accomplished

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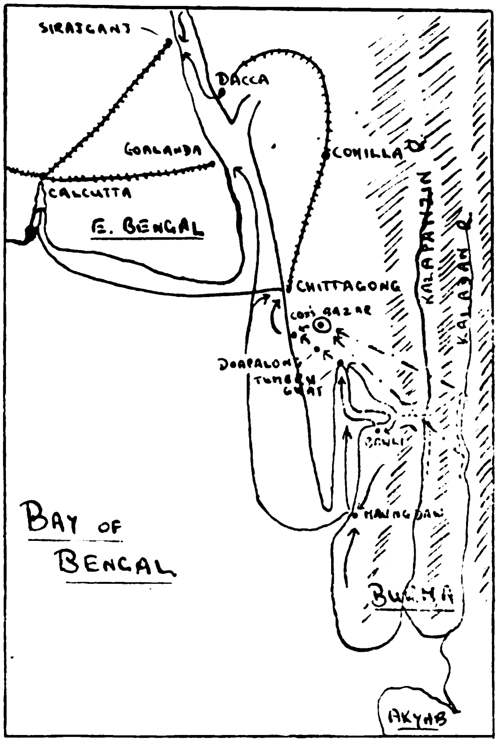
across the mountainous barrier which separates Northern Burma from the Brahmaputra valley in India. The peaks of these ranges are often over 10,000 feet high.

Diagram of Casualty Evacuation
The Arakan – Burma 1942-44



←——— EVACUATION BY ROAD, SEA OR RIVER.
+++++++ EVACUATION BY RAIL.
- - - - - EVACUATION BY MULE OR HAND CARRIAGE.
—•—• EVACUATION BY AIR.

Phase Two

The Defence of India's Eastern Frontier. Assam—1942

Streams of refugees and the remnants of the defeated forces from Burma trekked into north-eastern India by way of the Kabaw and Hukawng valley tracks. These valleys are highly malarious and the sickness and death-rates from malaria, dysentery, cholera, etc., were high. Hospitalization was difficult. An improvised ambulance train distributed the sick to hospitals in Manipur Road, Shillong and other areas in Assam. The remainder were evacuated into the interior of India to hospital centres as remote as Calcutta, Ranchi, Lucknow, etc. Evacuation was by the improvised ambulance train to Gauhati, ambulance river steamer for two days down the Brahmaputra river to Sirajganj, and again by ambulance train for one or two days to Calcutta or

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Lucknow. The flow of sick refugees from Burma was quickly followed by the monsoon and this in turn caused a great increase in sickness, especially malaria, amongst the troops stationed in Assam. Additional improvised ambulance trains were made available to cope with the rate of evacuation and steps were taken to make corridored ambulance trains, properly equipped with staff quarters and kitchen cars, available at a later date.

The First Arakan Campaign

After the 1942 monsoon and in the early months of 1943 offensive action was begun by our troops in the southern sector in the form of an advance into the Arakan. A divisional attack aiming at the capture of Akyab was launched from the eastern Bengal base and port of Chittagong. The problems of casualty evacuation in this tract of country were tremendous. Roads, where they existed, were atrocious, and aircraft were not available. Evacuation by river, chaung, creek and sea was the most comfortable means of transport. Even where this was practicable it was extremely slow and the number of suitable craft available was inadequate. The main feature of this evacuation was improvisation. A fleet of wooden barge-like Akyab sloops was obtained, together with smaller country craft of the sampan type. The former were used on the larger rivers and the latter on the smaller rivers and chaungs. Although slow and frequently dependent on tide, these craft were a great improvement on evacuation by ambulance car along the dusty unmetalled Arakan roads. The improvised Akyab sloops were replaced first of all by three creek steamers, and later by large metal flats capable of carrying up to 200 patients. The latter were stifling in the heat of the day, but no alternative was available, and the sickness rate was so great, especially from malaria and dysentery, that the larger craft had to be used.

For the brigade advancing along the Naf river and the coastal belt at the foot of the Mayu range of hills, water evacuation was always practicable, and the small and large river ambulance craft concentrated all sick and wounded at the head of the Naf river estuary, from where they could be conveyed by ambulance car to the forward hospital sited at Doapalong.

For the brigade advancing down the Kalapanzin river valley across the Mayu range of hills, the only practicable means of evacuation was by mules of the Field Ambulance Troop, and hand carriage by Indian Bearer Companies and local villagers. This was the method of evacuation in the Kalapanzin valley and across the Goppe Pass in the Mayu range. From the foot of the pass it was possible to evacuate by ambulance car to the forward hospital at Doapalong.

Even more difficult from the point of view of casualty evacuation was the position of a column of troops which crossed yet another range of hills from the Kalapanzin valley into the Kaladan river valley. For these troops river evacuation in small local country craft was occasionally possible, but the bulk of the evacuation was by mule and hand carriage. The local inhabitants of this remote valley, the Mogs, were experts at the improvisation of bamboo stretchers and slings, and carried patients with great care and skill over long

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distances. At Kyauktaw and Apaukwa this column improvised two light airstrips, and two Lysander aircraft, the only ones available for casualty evacuation in the Arakan at this time, evacuated a small number of the more seriously sick and wounded, until one of the aircraft crashed and the Japanese captured the strips.

Under these difficulties of evacuation, where distance came to be measured in hours of travel rather than in miles, the idea of siting small medical units or detachments along the line of evacuation for the purpose of "staging" casualties overnight was developed. These units provided rest, refreshment, medical attention and cover at night. Evacuation from Kyauktaw in the Kaladan valley by mule would take four days' journey to reach Taung Bazaar in the Kalapanzin valley, and a further two days to reach the foot of the Goppe Pass, where an ambulance car would take the casualty along bumpy tracks to the forward hospital at Doapalong.

In a similar way, and again owing to the nature of the country and means of communication, it was frequently necessary to stage casualties in hospitals sited at suitable distances along the line of evacuation from the fighting to the main base hospitals, sited in India. As many casualties as possible were held in hospitals at Cox's Bazaar, Chittagong and Dacca, but many had to be evacuated to bases in Northern and Southern India. Such patients would have staged in probably four hospitals and possibly numerous other field units, travelled in at least five different forms of transport, covered perhaps 1,000 miles, and taken from two to four weeks or longer.

The incidence of malaria during this campaign reached unimagined proportions. Medical units and the evacuation system were strained. Various medical units were improvised as an emergency measure, and these were later replaced by a unit called the Indian Malaria Forward Treatment Unit (I.M.F.T.U.). Their function was to hold, treat and rehabilitate up to 600 malaria patients in each unit.

The Development of Dacca as a Hospital Centre

To reduce long-distance evacuation to Northern and Southern India, a hospital centre was planned and sited in Eastern India, at Dacca. 5,200 British and Indian hospital beds were sited at Dacca, and later a further 1,000 African beds were added. The choice of Dacca as the hospital centre for operations along the Eastern frontier of India was mainly for logistical reasons. It was centrally situated for the Assam and the Arakan fronts. Good accommodation was available. It could be reached by river both from the mouth of the Brahmaputra in the south, and from Assam in the north. The metre gauge railway system connected Dacca with Chittagong in the extreme south-east of Bengal, and via the hill section with Manipur Road and North-East Assam. An excellent airfield was available a short distance from the hospital centre, and was connected by a good road. Climatically, Dacca was not by any means ideal for a hospital base, at any rate for British Troops. However, Shillong, the only area in E. Bengal and Assam with a cool climate

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suitable for such a hospital base, was completely inaccessible, except by long and difficult road journeys.

Wingate's Expeditions : Air Evacuation

At the beginning of 1943, Wingate's first experimental long range penetration force set out from Imphal and crossed the Chindwin to attack the Japanese L of C from Mandalay to MYITKINA. For this force there was no possibility of evacuating casualties other than carrying them with the column. In the case of one column, however, a Dakota transport aircraft was sent in to evacuate 17 casualties from a clearing in the teak jungle near BHAMO. This clearing was later selected as the "Piccadilly" landing area for the second (1944) Wingate expedition. In spite of the fact that the clearing was 400 yards short of the desired 1,200 yards minimum for a Dakota aircraft, the evacuation was successfully accomplished. General Wingate's experiences in this campaign prompted him strongly to recommend a fleet of ambulance aircraft for the evacuation of casualties. Having to abandon casualties in the jungle was too great a strain on the men and especially the commanders concerned. The effect on morale of an efficient and rapid casualty evacuation system, especially in long-range penetration behind the enemy lines, is very great.

At the Quebec conference in 1943 it was envisioned that all casualties should be evacuated by air from the second Wingate expedition into Burma. The Air Commando Force provided by the U.S.A.A.F. for the second (1944) Wingate expedition included L1 (Vultee Vigilant), L5 (Stenson Reliant), C64 (Norseman) and C47 (Dakota) aircraft equipped for this purpose.

Development of Comilla as a Centre of Communication and H.Q. 14th Army

During 1943, COMILLA became an important focal point in Eastern Bengal for operations against the Japanese. Its central position between the Arakan and Assam fronts; its location on the B. & A. railway from Chittagong to Manipur Road and Dacca, its suitability as a centre of signal communications and for airfield construction, were tactical reasons for its selection as H.Q. of the 14th Army and 3rd T.A.F. and for Reinforcement Camps. Hospital cover was made available for the number of troops in the camps and garrison only. Hospital areas were established for the Assam front in Imphal and for the Arakan front mainly at Dacca, with additional cover at Cox's Bazaar, Doapalong and Chittagong. When air evacuation from the Arakan was planned, Comilla was already the base for aircraft which would take supplies in and bring casualties out. Hence Comilla was destined to develop into the forward hospital area for the Arakan front for those patients who could be evacuated by air.

The Second Arakan Campaign

The second Arakan campaign began after the monsoon of 1943. The objective was again AKYAB, with a Corps attack instead of the divisional

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attack of 1942. Owing to a last minute withdrawal of landing craft for use in Italy, the combined operations attack from the sea had to be cancelled. For this reason, the attack followed the pattern of the 1942 campaign. One division advanced along the coast, west of the Mayu range, with MAUNGDAW as the first objective. A second division crossed the Mayu range at the GOPPE and NGAUKEDAUK passes and advanced down the KALAPANZIN valley with BUTHIDAUNG as a first objective. The 81st West African Division entered the KALADAN river valley via the SANGU valley. The latter was an extremely difficult journey by river and track.

Casualties were evacuated from the SANGU line of communication by river, using small country craft and staging overnight in I.S.S.s sited along the valley. The nearest hospital was at DOHAZARI, where there was a rail connexion with Chittagong. During the journey by river, the ambulance sampans had to negotiate a series of rapids. Once the division crossed the range from the Sangu valley into the Kaladan valley the country was suitable for the construction of landing strips, and air evacuation became possible. Strips for light aircraft (300 yards) were constructed in about three days, and for Dakota aircraft (1,200 yards) at the more important centres in about seven days. Evacuation of casualties by air became the only method of evacuation for this division. It was the first time that the sick and wounded of a division had been evacuated entirely by air, and the experiment was a complete success. Over 1,000 casualties were evacuated. The light aircraft and some of the Dakotas took casualties to aerodromes in the Cox's Bazaar area, and other Dakotas evacuated direct to Comilla.

The main feature of casualty evacuation from the divisions in the KALAPANZIN valley and west of the Mayu range was the development and use of jeep ambulances, capable of carrying two stretcher cases. This was made possible by the engineers constructing jeep tracks to the forward areas and over the passes in the Mayu range. It represented a tremendous advance over the mule and stretcher-bearer evacuation of 1942–43.

Another feature of this campaign was the concentration of medical units for the treatment and holding of uncomplicated malaria and light sick on the Naf peninsula. This lay close to, and at some stages opposite, the fighting. Three I.M.F.T.U.s and three C.C.S.s were sited in this area and these units made possible : (i) a very great saving in movement of the sick, and (ii) earlier treatment and more rapid return to duty of a large proportion of the sick.

The Naf river provided a smooth means of transporting the sick to these units and also protected the latter from Japanese attacks. The Japanese tactics of outflanking attacks on the L of C resulted in medical units often being overrun. The use of the Naf peninsula provided a solution to this problem.

The general lines of evacuation, apart from the above modifications, were similar to those of 1942–43, i.e. R.A.P. to A.D.S. to M.D.S. to C.C.S.s or M.F.T.U.s sited on the Naf peninsula. Fewer staging sections were required along the L of C owing to the more rapid evacuation obtained by using jeep ambulances. From the Naf peninsula the evacuation was by river to TUMBRU GHAT, by road to 125 I.G.H. at DOAPALONG and by river and road to

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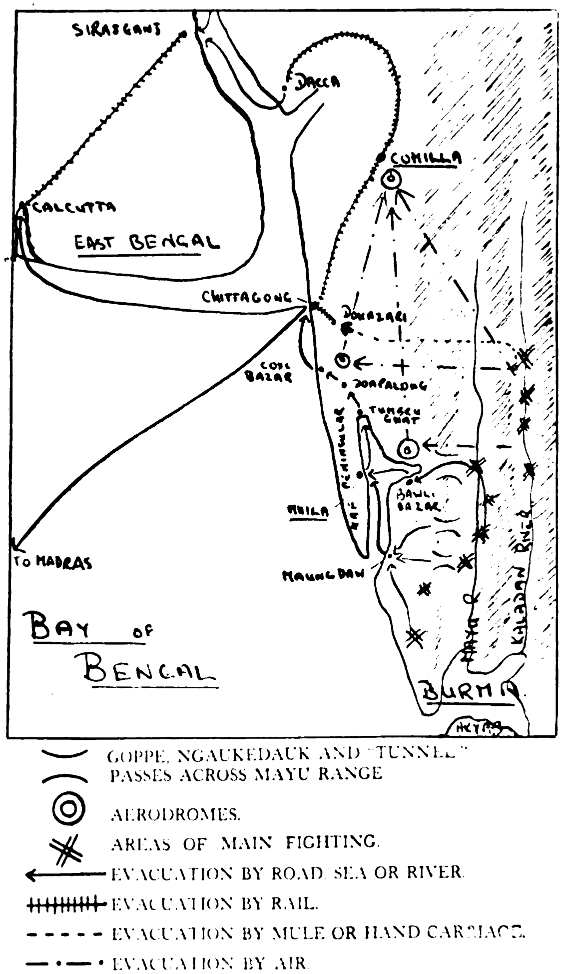
the Cox's Bazaar hospitals. Here more patients were held (300 B.T., 1,700 I.T. and 1,000 W.A. beds). Evacuation from Cox's Bazaar was by sea to Chittagong as in 1942–43, with greater use being made of the increased hospital cover in Dacca.

DIAGRAM OF CASUALTY EVACUATION DURING
THE SECOND ARAKAN CAMPAIGN 1943-44



The evacuation chain still involved a large number of stages and changes of transport. The flood of sickness was again so great that in spite of the use of I.M.F.T.U.s and increased forward hospital cover, numbers of relatively light sick were transported to base hospitals in India over 1,000 miles distant. Full use was made of the very limited air lift available from Bawli Bazaar and Ramu airstrips to Comilla. These patients were spared the long journey by river, road, sea and rail and were in hospital in Comilla in as many hours as would take days by the surface route.

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Wingate's Second Expedition – The Chindits of the 3rd Indian Division

In February 1944, the 3rd Indian Division was ready to strike from Imphal into Northern Burma, to destroy the Japanese line of communication. This operation was the sequel to General Wingate's first expedition in 1943. The advance guard reached the CHINDWIN by the end of the month. The main part of the operation was the fly-in by glider of two brigades, to selected landing areas on the Mandalay-Myitkina L of C. The landing areas were "Broadway" (North-East of Indaw) and "Piccadilly." The latter was the jungle clearing near Bhamo from which 17 casualties of the original Wingate expedition had been evacuated by Dakota aircraft. On March 5 "Piccadilly" was found to have been obstructed by the Japanese and all troops were diverted to "Broadway."

During the twenty-six days preceding D-day, light aircraft evacuated 700 casualties from the advance guard of the ground troops during their advance to the Chindwin. These patients were evacuated to the forward hospital area at Imphal, from improvised air-strips. L1 aircraft (Vultee Vigilant) were used mostly and they were called up by wireless to land on prepared paddy fields and jungle clearings to evacuate sick. Casualties would frequently be in hospital within four to six hours of being wounded. A number of casualties from a Commando force air-landed on the banks of the Chindwin, to the south of the main crossing, were evacuated by glider. The gliders were snatched up and towed to Imphal by Dakota aircraft.

The main force which landed at "Broadway" by glider sustained casualties during the night landing. By the next day, a strip suitable for Dakota aircraft had been improvised and these casualties were the first of many to be evacuated by Dakota aircraft from the 3rd Indian Division during its operations in Burma. A further landing was made by General Lentaigne's force near Inywa, 50 miles south of "Broadway," at a landing area known by the code name "Chowringhee."

As the Chindit columns moved north, harrying the Japanese L of C, to Myitkina, the Japanese launched their bold offensive across the Chindwin, surrounded Imphal and Kohima and threatened the base and railhead at Manipur Road. Hospitals forming the forward hospital area at Imphal and Kohima had to be rapidly withdrawn and deployed. They were divided into two groups, one group being withdrawn to Comilla and AGARTALA, where the aerodromes which were to supply Imphal were sited. The other group was withdrawn to the Brahmaputra valley in north-east Assam, to cover the fighting at Kohima and Manipur Road, and also to cover the evacuation from the Chindits, which had now to be switched to DINJAN, MARGHERITA, CHABUA and SYLHET aerodromes.

As the Chindits spread their area of destruction on the Japanese L of C south of Myitkina, further landing strips were constructed near strategic points. "Aberdeen" and "White City" were two such strips. The latter was sited near the rail block at HENU, which was the key position established by the Chindits. Considerable fighting took place for the strip itself and,

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during one period, ambulance aircraft were taking off with casualties, under fire from the Japanese who were holding the far end of the strip.

By early May, the strips "Aberdeen" and "White City" were evacuated and the strip "Blackpool" was developed in the Mogaung valley. By the middle of May, Stillwell was in charge of the operations designed to capture Myitkina. His American-trained Chinese, the American Marauders and British Kachin levies converged from the north, and the Chindit columns of the 3rd Indian Division from the south and west. The Air Commando Force was dissolved and General Old's Air Transport Command took over the task of supply and provision of aircraft for casualty evacuation for the Chindits. Aerodromes in North-East Assam were used by A.T.C. aircraft and all Chindit evacuation was now to hospitals at Panitola, Dibrugah and Ledo. The monsoon restricted evacuation to the all-weather strip at Myitkina, which was captured at an early date. The plight of the Chindit columns operating in the area west of Myitkina became serious when light aircraft could no longer use emergency paddy field and jungle landing grounds. The solution was arrived at by transferring British Sunderland flying boats from Coastal Command in Ceylon to the Brahmaputra at Dibrugah. Magnificent work was done by these flying boats, which were flown across the mountain barrier between north-east Assam and Burma to the Indawgyi Lake, west of Myitkina. Although these aircraft have a low "ceiling" they were flown across the mountains through monsoon cloud and storms. Some sorties were abortive owing to poor visibility and flying conditions. Frequently the pilots had to take their aircraft through cloud-filled gaps in the chain of mountains. On numerous occasions, the weather conditions were too bad to allow their fighter escort to accompany them.

During the period from the end of May to the beginning of July over 500 sick and wounded, collected from the Chindit columns and brought to Indawgyi Lake by mule and hand-carriage, were evacuated to safety by this means. Amongst those evacuated were seriously ill cases of "scrub" typhus. The casualties were loaded on to the flying boats from collapsible dinghies. Only one flying boat was lost during these hazardous flights and that was wrecked by floods whilst moored on the Brahmaputra river during a monsoon storm.

During July, the Chindits were withdrawn, having successfully completed their role, and they were replaced by the 36th British Division. Evacuation from the 36th Division was by A.T.C. aircraft, from Myitkina to north-eastern Assam.

The Battle of Imphal and Kohima—Development of Comilla and Agartala as Hospital Centres

The Japanese offensive against Imphal and Manipur Road was probably launched with the object of capturing the Chindit base and cutting the L of C to North-Eastern Assam. April and May of 1944 were critical months. The medical planning for the Northern front had to be completely reorganized. As mentioned above, the hospitals forming the Forward Hospital Area in Imphal and Kohima had to be withdrawn to Comilla, AGARTALA and

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North-Eastern Assam. The decision to form hospital areas at Comilla and AGARTALA had to be made because these were the base aerodromes from which Imphal was to be supplied. Transport aircraft returning with casualties could not be diverted and therefore hospitals had to be sited near the aerodromes. Again, owing to shortage of "Engineer" facilities, and to the enormous commitments with which the engineers had to compete, hospital sites and roads had to be improvised. Even so, improvised hospital and road construction took many weeks to be completed. As a result, only a portion of the casualties could be held at Comilla and AGARTALA, and the remainder had to be staged and further evacuated by ambulance train to the Dacca hospitals.

Thus the ideal of concentrating hospitals and bringing all casualties by air to Dacca could not be achieved, owing to the acute shortage of aircraft, and to the fact that the medical authorities had no ambulance aircraft which could be diverted at will. Throughout the battle for Imphal, one squadron of Dakota ambulance aircraft could have covered the evacuation of all sick and wounded into Dacca. The aircraft could have back-loaded supplies from Dacca airfields and peak periods of evacuation could have been covered by small evacuations in supply aircraft to Comilla and Chittagong, where hospitals were already available for garrison cover.

It was at this stage that the movement of troops and casualties by air on a large scale developed. Two divisions were flown from the Arakan to Imphal. Base installations, including hospitals, were evacuated from Imphal by air and No. 3 British Neurosurgical Unit was flown to Comilla. The latter move was unique in that the Unit did not cease to function. One aircraft carried 18 of the more seriously ill neurosurgical patients and treatment was continued immediately, by part of the unit, on arrival at Comilla.

Throughout the siege and battle for Imphal, the number of casualties evacuated by air averaged over 1,000 per week. In the early days of this evacuation, the tendency was to arrange mass evacuations at intervals, which invariably caused a certain amount of chaos and congestion at the receiving end. A smooth flow of evacuation was soon arranged. This did much to avoid a situation which occurred at Comilla, where, at one stage, a 1,000-bedded I.G.H. was holding 4,000 patients. The next difficulty to be overcome was the indiscriminate loading of aircraft, irrespective of destination, which had resulted in the Chittagong hospitals becoming grossly overcrowded. This obstructed the evacuation of long-term cases to Indian base hospitals, as all the cases from the Arakan and from Comilla and Dacca had to be staged in the Chittagong hospitals, preparatory to evacuation by hospital ship.

This overcrowding also caused the evacuation from Chittagong of slightly ill patients to make available empty beds. Casualties were eventually evacuated only to Comilla, with an overflow to Agartala when required. This enabled a more careful sorting of types of patient to be made. Long-term cases, who required more than two months' hospitalization, were evacuated by ambulance train to Chittagong to await further evacuation by hospital ship to the base hospitals in India Command. Patients who required less than

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two months' hospitalization were evacuated by ambulance train to the Dacca hospitals, and the shorter term sick were held, whenever possible, at Comilla and Agartala, near to the convalescent depots and reinforcement camps, through which they would eventually be returned to their units.

The Establishment of Air Evacuation

From this point, air evacuation became the established and only practical method of evacuation. The acute shortage of aircraft and the lack of control of the destination by the medical authorities had a very great influence on medical planning in the succeeding stages of the Burma campaign. Its influence in the establishment of hospital centres at Comilla and Agartala, instead of the ideal concentration of these hospitals at Dacca, has been outlined above. The outstanding achievement of air evacuation was the hospitalization of casualties far from the battle areas within a matter of hours. Air evacuation reduced the time lag in evacuation from the days required during 1943 to hours. This, compared with weeks required in the 1942 campaigns, represented a considerable advance.

Such concentration of large numbers of patients raised great difficulties in sorting, both forward at Imphal and at Comilla. A directive on the evacuation and distribution of sick and wounded was issued by the medical branch of the 14th Army. This directive was an attempt to improve the sorting of casualties throughout the line of evacuation. The objects aimed at were :

(i) The retention of all sick and wounded who could be expected to recover within a period of three weeks, in Forward Hospitals and Malaria Forward Treatment Units.

(ii) The efficient and rapid evacuation of all longer-term cases to Comilla, Agartala or Dacca, where all patients who could be expected to recover within two months were to be retained.

(iii) The rapid evacuation of all patients who would require longer hospitalization than two months to the base hospitals in India Command.

(iv) The early selection of certain special types of serious and urgent cases, such as gunshot wounds of the head, maxillo-facial, penetrating eye wounds, severe burns, fractures of the femur, etc., and their rapid selective evacuation to the specialist units where they could be treated most efficiently.

These cases demonstrated, more than others, that air evacuation, when efficiently organized and skilfully used by those selecting patients for evacuation, was a life-saving measure. The Air Surgeon of the U.S.A.A.F. classed air evacuation with blood plasma, penicillin, etc., as a means of saving life during battle.

The correct use of air evacuation is important. Evacuation at the wrong stage, for example, in burns cases, where secondary shock is likely to develop or, typhus patients after the fifth day and before convalescence, may be highly dangerous. The list of contra-indications for air evacuation include the following :

(i) Shock.

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(ii) Abdominal and thoracic wounds.
(iii) Acute abdominal conditions.
(iv) Recent severe hæmorrhage, including hæmoptysis and hæmatemesis.
(v) Gas gangrene.
(vi) Chemically gassed.
(vii) Pneumothorax.
(viii) Pneumonia.
(ix) Angina pectoris.
(x) Coronary occlusion during the first month.

It is suggested that air evacuation should be regarded as another instrument placed in the hands of the medical services with which to reduce mortality and morbidity and extend the availability of highly specialized medical treatment. To achieve the above, it is essential that aircraft should be available on the request of the surgeon or physician in charge of patients. An aircraft is frequently required urgently, and it is essential that, at least, a proportion of the aircraft allotted for casualty evacuation should be reserved *primarily* for a casualty evacuation role.

For such urgent use, the Norseman aircraft, produced by the Noorduin Aircraft Company in Canada, has many advantages. This aircraft was used by the American Air Commandos in Burma as a medium transport plane, and was known as the C64. It is capable of easy conversion to carry two or three stretcher patients, suspended by modifications of the standard webbing slings from the roof of the cabin, or it can carry five sitting patients. The Norseman has been used in Canada for snow landings with skis, it can also be fitted with floats, and was used to evacuate casualties in Burma during 1944–45.

The peacetime use of this type of aircraft as an ambulance plane in India and the Far East would greatly extend the area and increase the speed of availability of highly specialized medical treatment. The aircraft is a high-winged monoplane, giving easy access for stretcher bearers from all angles, with wide doors on each side of the cabin at stretcher hand-carriage height.

Phase Three

The Liberation of Burma

Introduction and Casualty Evacuation Scheme—1944–45

With the defeat of the Japanese offensives in the Arakan and at Imphal and Kohima, during 1944, largely by the use of air power, the stage was set for the third phase in the campaigns for Burma. This was the final reconquest of Burma by the 14th Army, the 36th British Division and the 15th Indian Corps. The 15th Indian Corps in the Arakan and the 36th British Division in North Burma were placed directly under the command of H.Q. Allied Land Forces S.E.A., whilst the large L of C areas of the 14th Army, 15th Indian Corps and 36th British Division, in Assam and Bengal, were administrated by an L of C Command. All hospitals were sited in L of C Command, whilst each Corps developed Corps Medical Centres, in duplicate, from Casualty Clearing Stations and Malaria Forward Treatment Units. Field

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Medical Units were attached to Divisions in the usual manner. The Central Group of hospitals in L of C Command at Comilla, Agartala and at Dacca were designated Advanced Base Hospitals and totalled approximately 12,000 beds.

A directive on the evacuation and distribution of casualties was issued by D.D.M.S. L of C Command on the instructions of D.M.S.A.L.F.S.E.A. The line of evacuation of casualties was to be as follows:

R.A.P.—

Field Ambulance	Corps Medical Centre	Advance Base Hospitals	Base Hospitals
(A.D.S. sometimes split off and forming additional link in chain.) *Function* First Aid and Emergency treatment.	Usually 2 C.C.S.s and 2 M.F.T.U.s with some special units, e.g. Ophthalmic Units, Head Injury Unit, Corps Psychiatrist, etc. *Function* Major Emergency treatment—holding all cases expected to be fit within 3 weeks.	*Function* Definitive treatment of all except long-term cases and treatment of special cases, e.g. Head Injuries, Gunshot Wounds of Femur, Maxillo-Facial Injuries, Severe Eye Injuries, Psychiatric Cases, Severe Burns. Holding all cases expected to be fit for discharge within 2 months (altered in 1945 after main battles to 3 months).	*Function* Long-term treatment of all kinds. Receiving all patients not expected to recover within 2 and later 3 months.

Air evacuation had already become the most important method of casualty evacuation in 1944. In the advance into Burma it was the only practical method and was used on a greatly extended scale. The medical planning was based on all-air evacuation from forward areas, whilst full use was to be made of the other surface methods of evacuation in rear areas.

The divided nature of the Advanced Base Hospitals Group, with hospitals sited at Comilla, Agartala and Dacca was not ideal, but the reasons for it have been traced in Phase II above. Shortage of aircraft and of engineer facilities sufficient to rebuild accommodation for 12,000 hospital beds at each move of the air supply base, even if this were desirable, and lack of control of the destination of casualty carrying aircraft by the medical authorities still made it impossible to centralize all the Advance Base Hospital beds in one area.

The Advance from Imphal to the Chindwin

The third phase began after the defeat of the Japanese army besieging Imphal, with Lord Louis Mountbatten's decision to fight on through the monsoon and pursue the defeated remnants of the Japanese forces from Imphal to Tamu and down the Kabaw Valley. Apart from the difficult mopping-up operations around Imphal and Kohima and along the hill tracks towards the upper Chindwin valley, the main drive took the form of two columns, one along the Tamu road to Sittaung on the Chindwin and down the

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Kabaw valley and the other along the hill road to Tiddim into the Chin Hills and then into the lower part of the KABAW valley.

Evacuation of casualties was difficult. Owing to the mountainous nature of the country and the rains precluding the use of other than all-weather strips, casualty evacuation by light aircraft from forward areas was impracticable. The evacuation service was thrown back to the methods used during the early Arakan campaigns, in country which was much more mountainous and was often more difficult to negotiate. The old methods of evacuation by hand carriage, mule carriage and jeep ambulance were resorted to. The unmetalled roads were soon churned to mud and, frequently, lengths of road became completely impassable to wheeled traffic. The continuous heavy monsoon rain caused frequent landslides along the hill sections of the roads, which were cut as ledges into the steep slopes. In the valleys, especially the KABAW valley, the wheels of the ambulance vehicles and jeeps would sink to the axles in the deep, sticky, black, alluvial clay. The four-wheel drive of the ambulance jeeps and cars could not compete and manhandling of the vehicles over the worst sections was resorted to by the East African, Indian and British troops. To quote a specific example of the difficulties encountered : A jeep ambulance convoy took two days and two nights to travel from Sittaung on the Chindwin river to Tamu, the nearest air-strip. This journey could normally be completed in a few hours, but mud and landslides caused the delays. From Sunle to Tamu, along the Kabaw valley stretches of the road were completely impassable to wheeled traffic. Stretcher carriage was resorted to from Pantha to Tamu, a distance of 7 to 10 miles. A section of river from Sunle to Tamu was found to be navigable and " Dukws " were brought up to evacuate the casualties by this route.

" Dukws " had already been used to evacuate casualties on stretches of the Pruma Chaung and the Naf River in the Arakan. They proved extremely valuable over short distances and avoided change of transport at road-river junctions along the line of evacuation. Stretchers could be placed on the decks of these vehicles. The main disadvantages were difficulties of maintenance, their large size and, in Burma, the difficulty in obtaining them for casualty evacuation work.

As the monsoon ended and the ground dried, it became possible to construct light aircraft strips along the Tamu-Kabaw valley road, but owing to the nature of the country, this was not possible along the mountainous Tiddim road. The aircraft evacuation made it possible to evacuate almost all serious cases. Hitherto, the very ill patients had been held forward in Field Medical Units as they were totally unable to withstand the physical hardships of the evacuation line. It was still necessary to hold the very ill casualties along the line of the Tiddim advance. Unfortunately these troops ran into one of the worst of the scrub typhus belts and the congestion in the forward units was extreme.

Along the Kabaw valley axis of advance, light aircraft strips were constructed at intervals of approximately 50 miles, and evacuation by L5 and Moth light aircraft was then possible. Evacuation of casualties by glider was

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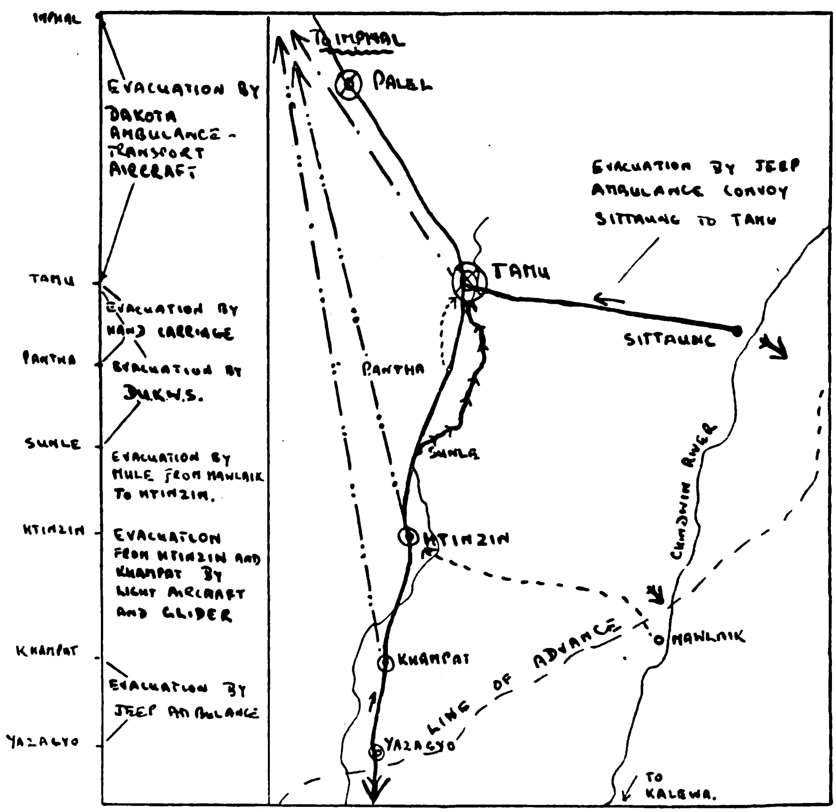
also carried out during this advance, where absence of trees made it possible for the Dakota aircraft to snatch the gliders from the ground by means of nylon ropes. For instance, WAYCO CG4A gliders were used to evacuate casualties from Khampat to Imphal until four gliders crashed on landing. There was no loss of life or major injury to the patients in this accident, but the aircraft were rendered unserviceable. The " Wayco " glider was able to carry up to 15 sitting patients, or four lying patients in double-tier stretcher slings and five or six sitting patients. The patients were accommodated in the cabin with the stretchers slung along the long axis of the aircraft on either side, immediately behind the pilot's cabin. The nose of the aircraft dropped to allow the loading and removal of the casualties.

The attached diagram shows the methods of evacuation which were used during the advance down the Kabaw valley. It will be noticed that whilst

DIAGRAM OF EVACUATION AT ONE STAGE OF THE ADVANCE FROM IMPHAL — KABAW VALLEY, 1944



AIRSTRIPS FOR HEAVY TRANSPORT AIRCRAFT.
LIGHT AIRCRAFT LANDING STRIPS.
LINES OF ADVANCE OF FORCES.
EVACUATION BY JEEP AMBULANCE OR D.U.K.W.s.
EVACUATION BY MULE OR HAND CARRIAGE.
EVACUATION BY AIRCRAFT (TRANSPORT, LIGHT OR GLIDER,

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the troops were operating just forward of YAZAGYO, a light strip was being constructed near this village. Evacuation by mule from the troops attacking MAWLAIK was necessary owing to the lack of jeepable tracks and the impossibility of constructing a light strip at that period. The evacuation by stretcher bearer from Pantha to Tamu and by "Dukws" from Sunle to Tamu was necessary until light strips were built and the roads became passable after the monsoon.

For the drive to capture KALEWA, 33 Corps sited the Corps Medical Centre in the area YAZAGYO-INBAUNG. The centre consisted of two I.C.C.S.s, one I.M.F.T.U., two I. X-ray units, one F.T.U., one Dental unit, one I.S.D.M.S., a Corps Psychiatric Centre, an M.A.S., an E.A.M.A.C., and three sections of American Field Service jeep ambulances. Here all casualties who were expected to be fit for discharge to duty within a period of three weeks were held and treated. Surgical cases were concentrated in the C.C.S.s, whilst all malaria and the majority of the medical cases were treated at the M.F.T.U. Casualties came in by light aircraft from MAWLAIK, NANZALEIN, KALEWA, etc., and "over three weeks" types of patients were re-evacuated in Dakota and Commando transport ambulance aircraft to the Advance Base Hospitals at Comilla. This Corps Medical Centre was a prototype of the Corps Medical Centres established throughout the advance into Burma. Approximately 60 per cent of casualties were held and treated at this level, and a considerable saving in man-power and casualty movement was achieved. Of the remaining 40 per cent which were evacuated to the Advance Base Hospitals, it was found that 25 per cent (i.e. 10 per cent of the total) required further evacuation to Base Hospital level for hospitalization longer than three months.

The Advance into Southern Arakan and Across Central Burma

With the capture of the bridgehead on the Chindwin River at KALEWA, the 14th Army was now prepared for the bigger operation, the advance across the plains of Central Burma to cross the Irrawaddy and capture Mandalay Further south the 15th Indian Corps was given the task of advancing down the Arakan coast by combined operations with the Navy and Air Forces. After air and sea bombardment, AKYAB was occupied by land from the Kaladan valley and by a landing from the sea. Ramree Island was captured. Having secured these two vital air bases, further landings were made on the mainland opposite Ramree Island behind the Japanese forces. Pockets of Japanese were cut off from their supplies and destroyed repeatedly until they were driven from Taungup into the Irrawaddy valley at the time that the 14th Army troops were advancing south from MEIKTILA to cut off their retreat.

Some of the fiercest fighting in the 15th Corps campaign was during the landings south of Akyab at MYEBON, KANGAW and AN, etc. The evacuation from the beaches was planned to take place in three echelons. Casualties were collected at a Beach Dressing Station formed by a Beach Medical Unit, where "first aid" surgery was carried out. They were then evacuated by L.C.M.s

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and L.C.T.s to an L.C.I.(D), commencing after the third wave of L.C.M.s and L.C.T.s came in. On this Depot craft there was a M.S.U. plus 100 beds where "emergency" surgery could be done. The third echelon in the forward evacuation from the beaches was to a hospital ship which ideally would come to within two miles of the shore. It will be appreciated that owing to the nature of the coast, with its long, tidal chaungs and shallow mangrove swamps, this ideal arrangement was not always practicable. Coastal ambulance steamers (the "Nulchera" and "Badora"—capacity 175 patients) and ambulance creek steamers "Agni," "Vanu" and "Lali" (capacity—40 lying and 60 sitting patients) were used. In emergency, as at KANGAW all manner of craft were pressed into use. The creek steamers operating with the 82 W.A. Division, between the remote chaungs and creeks at TAUNGUP and GIWA Creek and Ramree Island were equipped with radio to give information of arrival and numbers of patients, etc. This was extremely valuable and improved despatch and reception arrangements.

After the beach-heads were established, an attempt was made to "filter" the short-term cases (under three weeks) and evacuate them by coastal ambulance steamer to the Corps Medical Centre established at Akyab and later at Kyankpyu on Ramree Island. Light aircraft strips were constructed and the more serious cases flown quickly by L5 aeroplanes to the Corps Medical Centres. At Kyankpyu, the light aircraft strip was sited immediately adjacent to one of the C.C.S.s in the Corps Medical Centre, and casualties would be hand-carried from an aircraft taxied to within a short distance of the wards. After treatment here, the patients were evacuated by Dakota aircraft to the Advanced Base Hospital area at Comilla. Patients were also evacuated by ocean-going hospital ships ("Karoa," "Karapara," "Amarapoora," "Ophir," "Vasna," "Melchior Treub" and "Wu-Sueh") and were taken to Chittagong. At this port, the Advanced Base Hospital types of patients (prognosis indicating recovery within three months) were off-loaded to be despatched by ambulance train to Dacca, Agartala and Comilla, whilst long-term patients remained on board, and other long-term patients concentrated at Chittagong from the Advanced Base Hospitals and the Northern front, were embarked for Base Hospitals in India Command.

In the North, the main drive into Burma developed across the Chindwin. The 33rd Corps advanced to the line of the Irrawaddy, opposite and north and west of Mandalay. The 19th Indian Division crossed the Chindwin at Sittaung, marched across the jungle-covered mountains of North Burma to link up, near Wuntho, with the 36th British Division advancing south along the Irrawaddy from MYITKINA. Both these divisions drove south to take Mandalay from the north, the 36th Division taking the more easterly route across the Schweli river and through the Southern Shan States. Evacuation in the 33rd Indian Corps was almost entirely by air, taking the pattern of light plane evacuation to the Corps Medical Centre, and Dakota evacuation from this centre to the Advanced Base Hospitals at Comilla. The two Medical Centres of this Corps leap-frogged over each other during the advance. The main fighting took place at the battles for the bridgeheads over the Irrawaddy.

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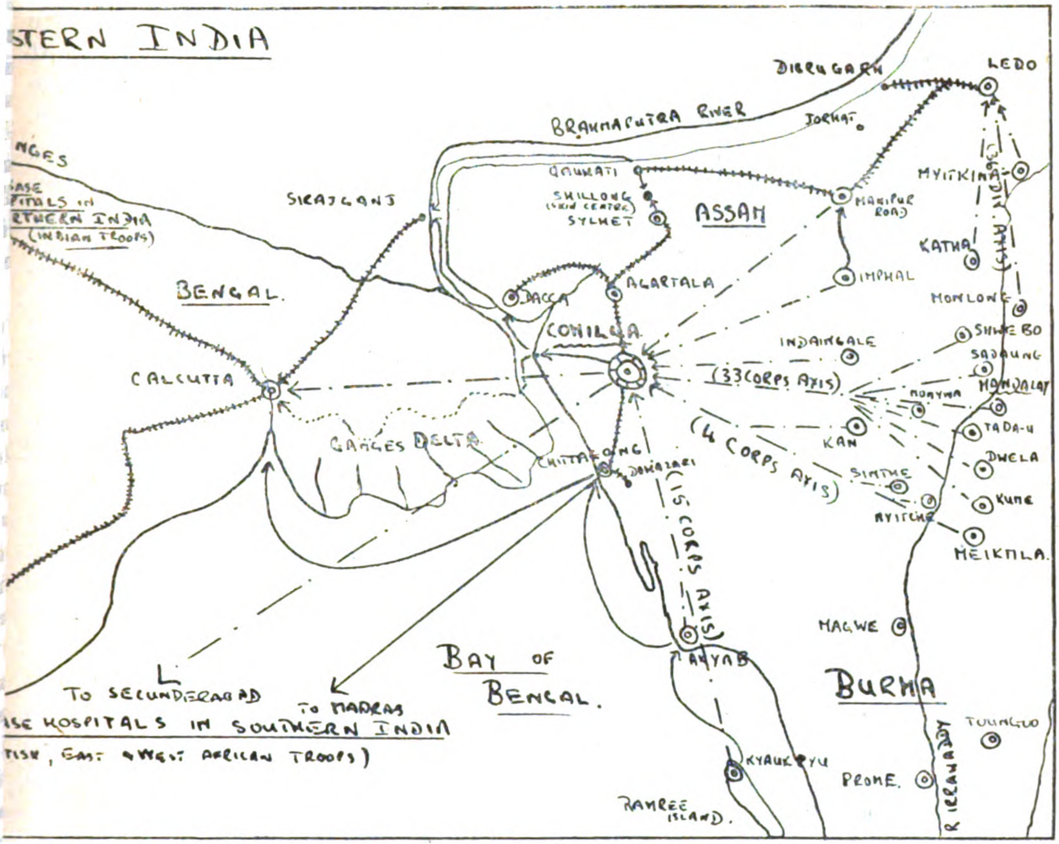
During March 1945, 4,052 casualties were evacuated from the 33rd Indian Corps Medical Centres to the Comilla Advanced Base Hospitals.

Whilst 33 Corps was advancing towards the Irrawaddy the 4th Indian

DIAGRAM OF CASUALTY EVACUATION ROUTES — BURMA, APRIL 1945



EVACUATION BY AIR.

EVACUATION BY SEA, RIVER OR ROAD.

EVACUATION BY RAIL.

EVACUATION BY RIVER ACROSS GANGES DELTA, USED ONLY OCCASIONALLY.

ADVANCED BASE HOSPITAL AREA.

AIR STRIPS.

Corps put in a large-scale armoured thrust across the Irrawaddy, south of Mandalay, captured MEIKTILA and cut the L of C and line of retreat of the Japanese forces in Mandalay. Evacuation was again by light aircraft to the Corps Medical Centres and Dakota aircraft to the Advanced Base Hospitals. During April, 3,736 casualties were evacuated from 4th Corps Medical Centres

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to Comilla. The total light aircraft evacuations for the two corps were 8,309 in March and 4,950 in April; and for Dakota aircraft, 6,608 in March, and 4,720 in April.

Organization of Air Evacuation

The organization of the air evacuation was briefly as follows:

(1) Medical branches of the formations concerned estimated the approximate number of casualties which would require evacuation each day: (*a*) by light aircraft to the Corps Medical Centre; (*b*) from Corps Medical Centre to the Advanced Base Hospital Group.

(2) These figures were transmitted to the Army Air Transport Organization at fortnightly intervals and aircraft allocations made accordingly. Any operational variation from the planned requirement was signalled immediately to this organization, who requested diversion of R.A.F. aircraft accordingly.

(3) E.T.A.s of transport ambulance aircraft (1(*b*) above) were signalled to the forward evacuation units on the strips and the formations concerned.

(4) Light aircraft normally worked on direct request from formations, i.e. the Division or perhaps Brigade to the squadrons concerned.

(5) The Casualty Evacuation Units used on the airstrips in Burma were mostly Indian Staging Sections (could handle efficiently 200 patients per day) and occasionally Indian Field Ambulances (could handle 1,000 patients per day). Towards the end of the campaign, R.A.F. Casualty Air Evacuation Units were used to reinforce the I.S.S.s, and were admirable units for dealing with British Troops. These units were responsible for staging the casualties whilst awaiting the arrival of aircraft and loading the aircraft. An ambulance pool was attached to these units.

(6) At the receiving aerodrome, an aircraft carrying casualties, on approaching the circuit of the airfield, informed the control tower by radio of the number of lying and sitting patients carried. This was passed on to the evacuation unit, together with the unloading bay number. The aircraft was unloaded and the patients given food, rest and any necessary medical attention before being distributed to the appropriate hospital in the Advanced Base Group.

(7) No additional documentation other than the Field Medical Card 3118 and 3118A was considered necessary. Manifests were prepared in triplicate for the number of patients making a Dakota load and were distributed to the despatching and receiving units, the third being retained by the pilot.

Final Stages of the Reoccupation of Burma

After the defeat of the Japanese forces at Mandalay, the 4th Corps and 33rd Corps of the 14th Army advanced along the Mandalay railway line and down the Irrawaddy valley respectively, to Rangoon, whilst the 15th Indian Corps mounted a combined operation from Ramree and Akyab. During this advance, the troops outdistanced the economic pay load of a Dakota aircraft from the Comilla airfields. In addition, large numbers of transport aircraft

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were withdrawn and it became necessary to stage casualties through Akyab and Ramree, and later, to stage them at Chittagong and evacuate to the Advanced Base Hospitals by ambulance train from this point. This unfortunately prolonged the evacuation time considerably, but by this time all the more severe fighting had finished and the numbers to be evacuated fell considerably.

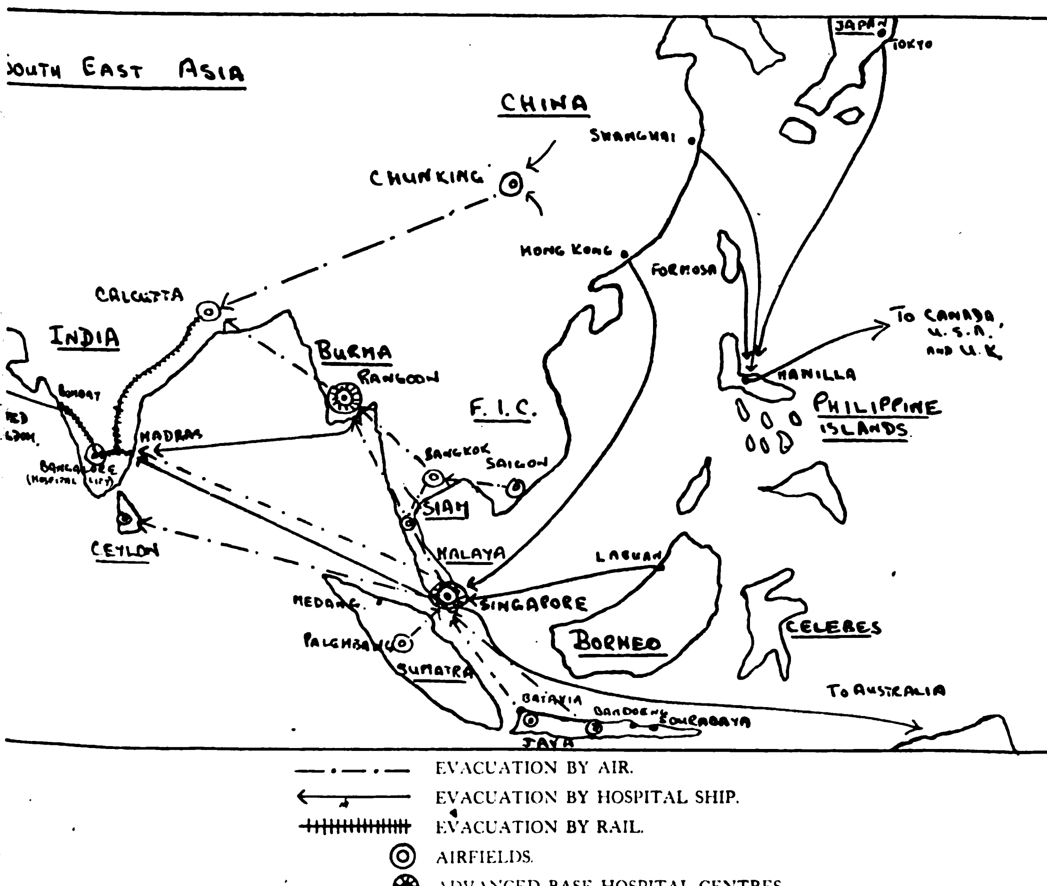
Phase Four

The Occupation of Burma and After

The Establishment of an Advanced Base Hospital Group in Rangoon

The medical planning for the occupation of Burma and subsequent operations against the Japanese, included an Advanced Base Hospital Group consisting of 10,000 beds, at Rangoon. Owing to the early conclusion of the

Diagram of Evacuation of Casualties and Sick Recovered P.O.Ws, Oct: 1945



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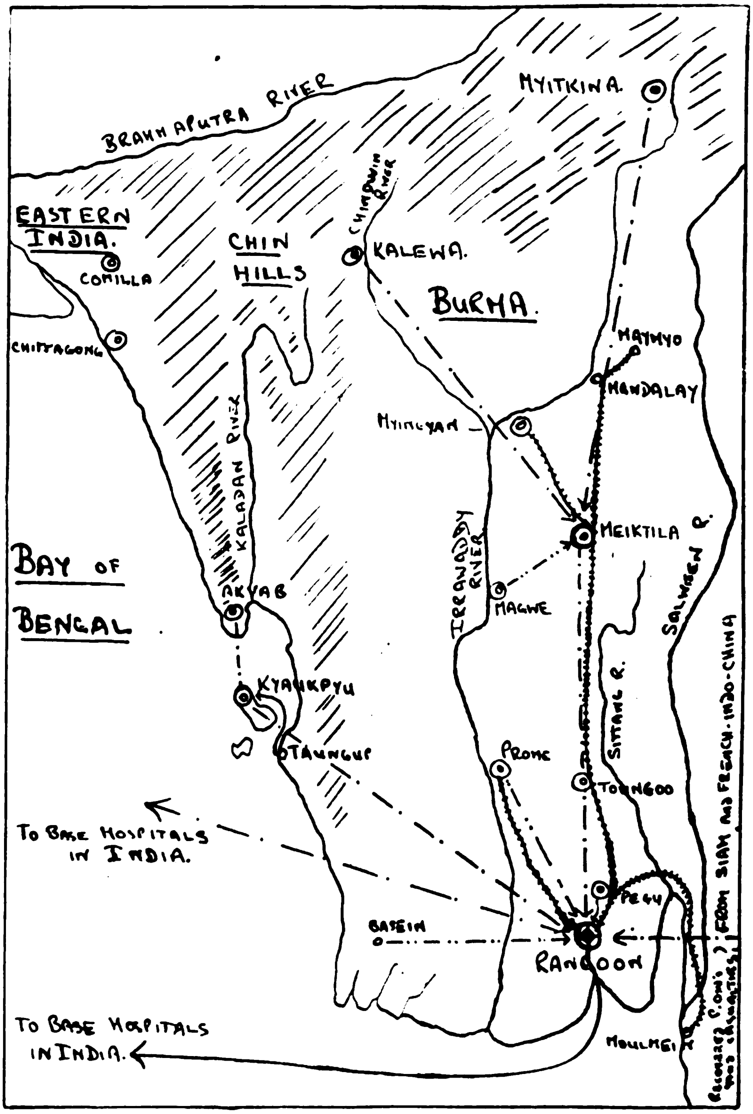
CASUALTY EVACUATION PLAN FOR BURMA, 1945



EVACUATION BY SEA OR ROAD.
EVACUATION BY RAIL.
EVACUATION BY AIR (TRANSPORT AIRCRAFT).
(LIGHT AIRCRAFT.)
AIRFIELDS.
GARRISON HOSPITAL CENTRE AT MEIKTILA.
ADVANCED BASE HOSPITAL CENTRE AT RANGOON.

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fighting in South-East Asia, this number of beds was only reached as an emergency measure to cope with the sudden influx of Recovered Allied Prisoners of War and Internees.

Approximately 16,000 R.A.P.W.I. were evacuated from Siam and French Indo-China by air to the hospitals in Rangoon, during the last week of August and September 1945. The large majority were flown from Bangkok. Those evacuated from Saigon in F.I.C. were staged at Bangkok *en route* to Rangoon.

The proposed evacuation plan for the occupation of Burma is shown in the diagram. The Advanced Base Hospital Group at Rangoon was designed to hold patients whose recovery was expected within three months and included special units for the treatment of such highly specialized types of case as maxillo-facial, head injury, severe burns, gunshot wounds of the femur, severe eye injuries and certain psychiatric patients. Hospitals sited at MEIKTILA and KALEWA were designated Garrison Hospitals and held "up to three months" patients apart from the highly specialized cases listed above.

The Occupation of Malaya and South-East Asian Territory Held by the Japanese

A similar plan to the one for Burma outlined above was envisaged and put into operation for the evacuation of R.A.P.W.I. in September 1945. An Advanced Base Hospital Group was built up in Singapore. The aim was eventually to site 8–10,000 hospital beds in Singapore. Evacuation was by transport-ambulance aircraft and hospital ship from the Garrison Hospitals sited in Java, Sumatra, Borneo, Malaya, Siam, French Indo-China, Hong Kong and Japan, to the Advanced Base Hospital Groups at Singapore and Rangoon. This plan was in operation for R.A.P.W.I. and other sick for all the areas mentioned above, with the exception of Japan, in October 1945.

In this way, considerable saving in man-power loss from sickness, hospital beds, and certain specialists and specialist equipment was effected.

APPENDIX

Air Evacuation Statistics for 1944 and 1945 (January to September)

Date	*Evacuated by light aircraft from battlefield to Corps Medical Centres*	*Evacuated by transport ambulance aircraft from Corps Medical Centres to Advanced Base Hospital Groups*	*Evacuated from Advanced Base Hospital Groups to Base Hospitals*	*Evacuated by transport aircraft from base areas of Bengal and Assam to Advanced Base Hospital Groups*	*Evacuation of sick R.A.P.W.I. by transport aircraft*	*Grand totals*
1944	2,363 +	67,321	5,897	—	—	75,581
1945	20,818 +	43,113	7,265	13,012	18,578	102,786
	23,181	110,434	13,162	13,012	18,578	178,367

N.B. + = figures very incomplete.

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I would like to express my thanks to Lieutenant-General T. O. Thompson, D.M.S. Supreme Allied Command, South-East Asia, later D.M.S. in India, for kindly allowing me to refer to his personal notes of the early stages of the Burma Campaigns and for other assistance, also to Major-General W. Tyndall, D.M.S. Allied Land Forces, South-East Asia, and to Brigadier H. G. Winter, formerly D.D.M.S. 14th Army and L of C Command. I wish to thank the D.G.A.M.S. for permission to publish this paper.

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A SURVEY OF THE HISTORY OF THE MEDICAL SERVICES OF THE ARMY PRIOR TO AND SINCE THE FORMATION OF THE R.A.M.C.

BY

Lieutenant-Colonel A. L. PENNEFATHER

Royal Army Medical Corps

Period up to 1660

Up to this time there was no Standing Army and, in the event of war, medical and other Departmental Services had to be improvised. Medicine and Surgery, as we know them to-day in the Army, did not exist. Some Senior Officers had their own private Medical Attendants.

In 1645, Cromwell raised an Army which was disbanded by Charles II in 1660 except for Monks Regiment—later the Coldstream Guards. This marked the beginning of the first permanent Standing Army.

1660–1854 Standing Army. No Medical Corps

At this time each regiment had its own hospital staffed by a Serjeant (known as Hospital Serjeant) and Hospital Orderlies belonging to the regiment. The Medical Officer wore the uniform of the regiment to which he was attached, and some had the honour of possessing double commissions.

There was, however, no ordered plan for the evacuation of the sick and wounded. It was not until 1805 that J. G. V. Millingen, M.D., put forward a scheme for the formation of a Hospital Corps and published, at his own expense, a "Medical Officers' Manual on Active Service." In his book he went into the matter in some detail and included a uniform to be worn by a private of the Hospital Corps—*vide* reproduction.

At this time also strong D.G.sA.M.S., were coming to the fore who saw the need for more highly organized and efficient Medical Services. Notable amongst these was Sir James McGrigor, held in high regard by the Duke of Wellington.

1854–57 Crimean War—Hospital Conveyance Corps
First Medical Staff Corps

At the beginning of the Crimean War a Hospital Conveyance Corps was formed. This was recruited from unemployed pensioners in London and proved to be a failure, the cause of which may be summed up in the words of Sir Andrew Smith, then D.G.A.M.S.: "I want strong men, not old feeble pensioners who can hardly carry themselves, let alone the wounded."

The following year (1855) the first Medical Staff Corps for Hospital Services was formed with its H.Q. and Depot at Chatham. A Regimental Officer was made Commanding Officer and it consisted of 9 Coys. each 120 strong. The Commanding Officer was his own Adjutant and Quartermaster and had very

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few N.C.O.s to assist him in his task. Nevertheless, history records that he held three parades a day and taught his men to salute ! The technical aspect of the recruits training was undertaken at the General Hospital, Chatham, where the new recruits were given fourteen days' training. At the end of that time they were examined and, if successful, were posted for duty to the General Hospitals at home or in India.

The hospital organization consisted of two main departments : (a) Purveyors Department, comprising the stewards issuers, washermen and cooks, and (b) Surgeons Department comprising the wardmaster, barbers and nursing orderlies. Ranks were granted only for the purpose of allowance, e.g. washermen were Corporals.

The duties of the orderlies were summarized as follows : to apply fomentations, feed helpless patients, keep the ward clean, exchange the linen and attend generally to the wants of patients.

The first Medical Staff Corps, though a step in the right direction, did not prove a success, for three principal reasons. It had no officers of its own, recruits received only limited training, and it served only hospitals.

1857–84 Army Hospital Corps

In 1857 the Army Hospital Corps followed.

One new feature of this Corps was the subdividing of the Surgeons' Department into Medical Staff consisting of Medical Officers who had no disciplinary power and General Staff with Captains of Orderlies seconded from Regiments. The Recruits for this new corps were volunteers from regiments, who were required to possess the following qualifications, able to read and write, steady habits and of a kindly disposition. Furthermore, General Duty N.C.O.s were appointed and chevrons were introduced. Personnel were liable to be called upon to assist in carrying wounded from the Field of Battle.

Nevertheless, it will be seen that the same mistake was made in the new Corps of 1857 as was made in the first Medical Staff Corps, namely that it had no officers of its own. The personnel were " nobody's child " and often looked upon with disfavour by the unit to which they were attached.

It was not until 1873 when the Regimental System was abolished and the Corps consolidated its position under officers of its own that the new organization began to function properly. Captains of Orderlies and Lieutenants of Orderlies were now appointed to commissions in the Army Hospital Corps and later took over the duties of Quartermaster.

In the meantime in 1860 an Army Medical School for officers was formed at Chatham. This prepared the way for the transfer of administrative control from the Officers of Orderlies to the Medical Officers.

In 1875 the Depot moved to Aldershot. The Commanding Officer bore the rank of Deputy Surgeon-General, the Chief Instructor was Surgeon Major and the Adjutant was an Officer of Orderlies. This was an important step towards the formation of a self-contained organization within the framework of the Army.

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1884–98 Second Medical Staff Corps

In 1884 the Medical Officers and Quartermasters were consolidated into the Medical Staff and the Army Hospital Corps was redesignated the Medical Staff Corps.

In the same year, the Second Medical Staff Corps accompanied the Nile Expeditionary Force to Egypt, to raise the siege of Khartoum. Casualties were heavy, both in officers and men and typhoid fever reached epidemic proportions; nevertheless, in spite of many adversities, the second Medical Staff Corps proved its worth.

1898–1914 Birth and Growth of the R.A.M.C.—South African War

In 1898, by Royal Warrant the Medical Staff and the Medical Staff Corps were united to form the "Royal Army Medical Corps," with Ordinary Army ranks and titles throughout. A badge was also granted with the motto *In arduis fidelis* (faithful in adversity).

One year later in 1899 the newly formed R.A.M.C. was put to the test in the South African War in which half a million troops were engaged. The fact that 6 V.C.s were awarded to the R.A.M.C. testified to the part played by the Corps in this campaign.

1914–18 World War I

In the Great War of 1914–18 the R.A.M.C. once more went into action, now a unified Corps of Officers and men working together. It is a fitting tribute to the R.A.M.C. that preventable sickness was lower than in any previous war. Collection and evacuation was quicker despite heavier casualties. These two factors had a profound effect on morale.

1939–45 World War II

The 1939–45 War presented many new features. For example the swift manœuvre and wide-scale operations of Desert Warfare on the one hand, and the problems of evacuation in Jungle Warfare on the other, made it necessary for the R.A.M.C. to adapt itself accordingly and to be considerably more flexible. A number of mobile specialist units were formed, such as Mobile Surgical Units, Mobile Transfusion Units, Parachute Field Ambulances, to mention but a few of the many Units which now constitute the Medical Organization of the Field Force.

It is interesting, however, to note a return to some of the older ideas in the sphere of administration, e.g. the appointment of non-medical officers to the R.A.M.C. for certain duties such as Stretcher Bearer Officers, Technical and Administrative Officers, Registrars of Hospitals, etc.

Furthermore, as a result of experience gained in the 1939–45 War, it is now proposed to augment the Regimental Medical Establishment by a Serjeant R.A.M.C. and four Corporals R.A.M.C. similar to the days when the Regimental Medical Organization comprised the whole Medical set-up.

Finally it is submitted, that although the fundamentals of Nursing as laid down in the Medical Staff Corps (1855–57) under the heading of duties of Orderlies, have not materially altered, as the R.A.M.C. Nursing Orderly and

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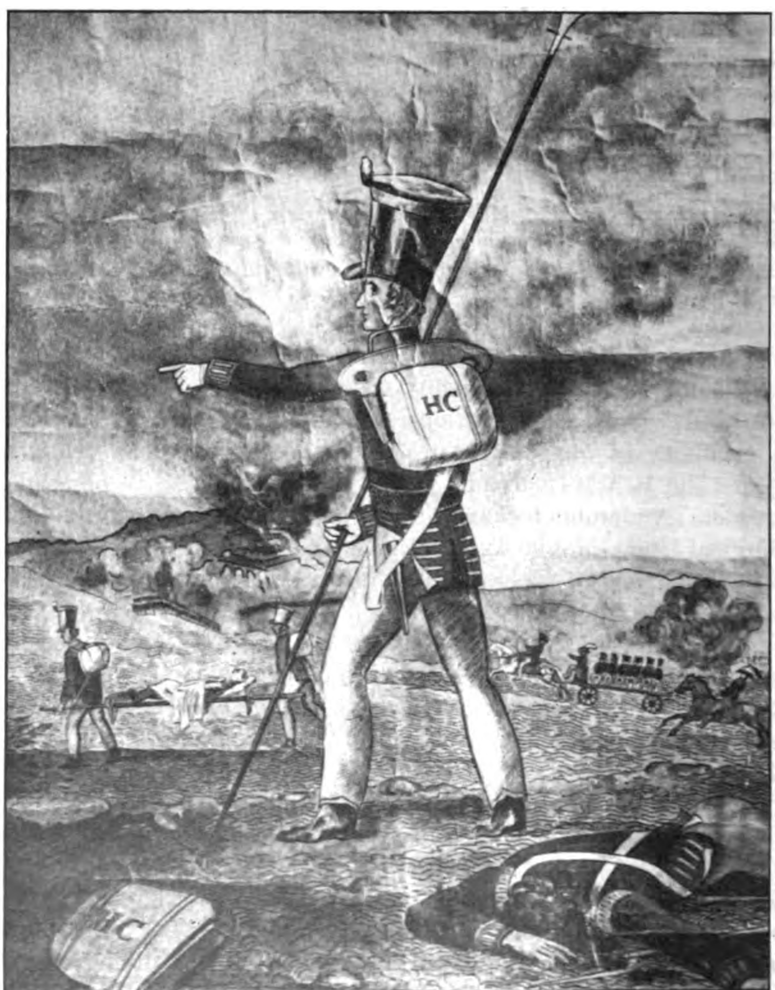
Junior N.C.O. of to-day are liable to be placed in positions of considerable responsibility. To take but one example, the Corporal R.A.M.C. attached to a Company of Infantry in action may find himself a long way from a Medical Officer, but everyone around him will expect him to know what to do.

His forerunner in the Army Hospital Corps was required to be able to read and write, to be of steady habits and a kindly disposition, these qualifications he must surely possess.

He will need in addition, however, all the qualities required of a Junior Leader in a combatant Unit, particularly a sense of responsibility and courage based on knowledge which will enable him to act on his own initiative and in a spirit of teamwork with his officers.

His present status indeed stands out in making contrast to the days when the Hospital Orderlies were apt to be regarded necessary, but rather a nuisance and " nobody's child."



PRIVATE, HOSPITAL CORPS

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Clinical and Other Notes.

TWO CASES OF ACUTE PERITONITIS OF APPENDICAL ORIGIN

BY

Lieutenant-Colonel J. HUSTON, M.B., F.R.C.S.Edin.

Royal Army Medical Corps

Case 1.—*Acute Appendicitis, Post-operative Ileal Volvulus.*

The patient, aged 19, whilst on leave, was seized with central abdominal pain accompanied by vomiting. Though his symptoms persisted, he did not seek admission to hospital until forty-eight hours later.

On admission (11.3.47) the abdomen was very guarded with marked tenderness in the right iliac fossa. Temperature 100° F., pulse 88, respirations 22. His general condition was satisfactory.

Operation was advised and performed two hours later by Major C. P. Rowlands, R.A.M.C. Through a McBurney incision, a swollen acutely inflamed unperforated appendix was removed without difficulty and the abdomen closed.

Progress.—There was some cough, slight abdominal distension, raised pulse (94) and increased respirations (28) during the next thirty-six hours. Then there was a little vomiting on the second afternoon with increasing colic and the absence of flatus. A repeated enema gave no result. Lower small gut obstruction was diagnosed.

Second Operation.—Thin sero-purulent blood-stained fluid escaped on opening peritoneum and coils of inflamed small intestine, which required decompression, presented. The cæcum was collapsed. Thicker pus welled up on disturbing the coils in the pelvis. A volvulus of mid-ileum, twisted anti-clockwise 180 degrees was found and reduced. It affected 3 feet of bowel; the wall was heavily engorged, had fair lustre, but areas of gangrene (6 × 4 cm.) at either extremity of the loop, necessitated resection, which was done without clamps and a side-to-side anastomosis effected. After aspiration, the abdomen was closed.

After-treatment.—He was given 1,000 c.c. of blood and thereafter the usual intravenous drip, 2,500 c.c. daily. Naso-gastric suction was installed.

Intramuscular penicillin 200,000 units was given two-hourly for 5 doses, then at three-hourly intervals for three days, then at increasing intervals over the following week. Total dosage of penicillin 9,400,000 units.

Progress.—On the first day after his second operation he was very ill and restless. Temperature 99·4°, pulse 120, respirations 28. Stomach contents, 17 ounces aspirated.

Second day: Much the same, urinary output going up.

Fourth day: Abdomen softer, borborygmi heard. Fluid by mouth increased and gastric suction interrupted.

Sixth day: A cellulitis, noted earlier around the outer part of the McBurney incision required evacuation of pus ("mixed growth, *B. coli* predominating").

Seventh day: Bowels open. Temperature 98° F. Much improved.

Twenty-eighth day: A barium meal showed a normal follow through. Wounds soundly healed. Looks and feels fit on ordinary diet.

Case 2.—*Missed Pelvic Appendicitis, Diffuse Peritonitis.*

A soldier, aged 21, was admitted on 26.10.47 from his unit, with moderate abdominal

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pain of eighteen hours' duration; "no vomiting of note, bowel movements normal." He gave a history of having had acute gonorrhœa in April 1947.

On admission the abdomen was unguarded, though on deep palpation there was tenderness in the epigastrium and in both iliac fossæ. The pulse and temperature were normal. *Per rectum :* the prostate was tender and the right vesicle, tender and palpable.

Twenty-four hours later a urethral discharge was found and he was transferred to a venereal ward with the other clinical features unchanged. Later they became worse. He was first seen by me on the evening 29.10.47 (some ninety hours after onset of abdominal pain). He was then very ill, cyanosed, with sordes on the lips and a dry brown tongue. There had been a little bilious vomiting. Temperature 100°, pulse 110, respirations 20.The abdomen was guarded all over, tender and silent.

Operation (29.10.47).—Exploration, through a right lower paramedian incision, discovered the right abdomen and pelvis full of quantities of thin malodorous pus. All bowel seen was distended and showed intense serosal injection. A large gangrenous perforated appendix, adherent to the right iliac vessels was removed, as well as some free fæcoliths in the pelvis. Pus was removed carefully by suction and the abdomen closed without drainage.

120,000 units of penicillin was given with 500 c.c. of plasma on the table and gastric suction arranged.

After-care.—Glucose-saline one bottle plus 2,500 c.c. dextrose-water solutions was given intravenously, daily, for three days. Intermittent intramuscular penicillin 120,000 units was given three-hourly for the next seven days. Total penicillin dosage 6,840,000 units.

Progress.—This patient was very sick for the next forty-eight hours. There was a very large return of gastric contents until 31.10.47 when he settled down and the tongue cleared and became moist and the pulse-rate dropped to 90/86.

1.11.47 : Abdomen softer. Bothered with hiccough. On the whole easier.

2.11.47 : Had a better night. Abdomen soft. Peristalsis heard. Gastric suction stopped.

3.11.47 : Passed flatus.

4.11.47 : One skin suture showed a stitch abscess. Laboratory report on pus from it showed a "few Gram-positive cocci and Gram-negative bacilli. Culture: *B. coli* only isolated."

8.11.47 : Temperature normal. General condition very satisfactory.

17.11.47 : Getting up.

20.11.47 : Sent to Convalescent Depot for one month. On his return he was fit and had a sound scar.

Comment.—This type of case is not uncommon in young soldiers. The initial features were equivocal and the urethritis was a "bad red herring."

Discussion.—Prior to the advent of penicillin the mortality in these cases was about 33 per cent (Meleney *et al.*, 1931). Using massive doses of parenteral penicillin, Crile (1946) obtained striking results in peritonitis of appendical origin.

Appendicitis heads the list of causes of acute peritonitis. The axiom "frapper vite et frapper fort" (Selbie, 1947) may have a wide application in the varying conditions of Service surgery.

I am indebted to Colonel W. C. MacKinnon, Officer Commanding, Military Hospital, Cowglen, Glasgow, for permission to publish these notes.

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INTENSIVE PENICILLIN THERAPY IN FREE PERFORATION OF CARCINOMA OF SIGMOID COLON

BY

Lieutenant-Colonel J. HUSTON, M.B., F.R.C.S.Edin.
Royal Army Medical Corps

FREE perforation at or near the tumour in carcinoma of the colon is fortunately a rare event in a young subject. The ancillary use of chemo-therapeutic substances in the presence of peritonitis is important (Black and Evert, 1946) and appears to have improved the prognosis in what was formerly an often fatal condition. For these reasons the following case is recorded :

A Sapper, aged 21, complained of sudden onset of acute colicky pains in his abdomen accompanied by vomiting, on October 1, 1947. His bowels had been opened on the previous day but he had, for a long time, some irregularity of bowel habit and took laxatives when necessary. He had noticed a swelling in his right groin for some months. He was admitted to hospital eight hours after the onset with the provisional diagnosis of strangulated inguinal hernia.

On Admission.—A spare young man, looking ill ; temperature 100·8° F. ; pulse-rate 90 ; respirations 22. His lips were dry as was the tongue which showed a central dark brown fur. He vomited twice within two hours of admission. The abdomen was moderately distended, guarded and tender above the pubis and over both iliac fossæ. No masses could be felt in it. Borborygmus was heard. Rectal examination was negative. A hernia reaching the upper scrotum appeared to contain omentum and bowel. It was not tender and reduced easily. X-ray examination of the abdomen was not done.

Operation (four hours after admission).—The abdomen was opened through a lower right paramedian incision ; on opening peritoneum a quantity of thin malodorous fluid and gas escaped. The lower loops of intestine showed evidence of early inflammation but there was little distension in these or in the proximal colon and cæcum. Some 20 ounces of fæcal-stained pus was in the pelvis but no gross extravasation of bowel contents. The transverse colon was high up in the abdomen and was not disturbed. An annular thick hard growth completely encircling the middle of the sigmoid colon was found. It was lightly adherent to the fundus of the bladder. On the antimesenteric surface of the proximal lip of this tumour was a circular perforation, which admitted the tip of a 4-inch Spencer-Wells forceps. From it a few bubbles of gas escaped. The related inferior mesenteric and para-aortic glands were enlarged and felt craggy.

The affected loop was separated from bladder, exteriorized through a left iliac incision and prepared for a staged resection. A Paul's tube inserted into the proximal loop allowed free drainage. A rubber tube drain was brought from the pelvis through the lower part of the approach incision.

120,000 units penicillin was given with the intravenous drip installed at operation. Nasogastric suction was used for the first twenty-four hours and then discontinued as it was not needed. The drainage tube from the pelvis discharged a little pus (odourless and sterile on culture after forty-eight hours) and was removed on the third day. By then the temperature reached normal and the abdomen was soft.

The exteriorized tumour was resected on the eighth day and the spur gradually crushed. The bowels began to move *per via naturales* on the twenty-sixth post-operative day. His colostomy shrunk well and was closed during the tenth week.

The patient gained 6 lb. in weight during the period, the abdominal wall was sound, a barium follow-through was normal and he felt and looked very well on leaving hospital.

The tumour was verified pathologically as an adenocarcinoma.

In the immediate post-operative period penicillin was given by intermittent intra-

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muscular injections three-hourly for eight days, then six-hourly for two days. Total penicillin, 8,660,000 Oxford units.

I am grateful to Major W. Wilson, R.A.M.C., for referring this case to me, and to Colonel Wm. MacKinnon, my Officer Commanding, for permission to submit this note for publication.

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AN UNUSUAL CASE OF OSTEITIS DEFORMANS (PAGET'S DISEASE)

BY

Lieutenant-Colonel W. F. L. FAVA and Captain J. D. HALLISSY
Royal Army Medical Corps

Osteitis deformans is an uncommon disease of bone occurring in middle-aged or elderly subjects of either sex in the proportion of three males to two females. The condition is characterized by osteoporosis of the bone affected, with consequent softening and deformity. Changes may involve the whole skeleton, or one bone, or a group of bones. It is only exceptionally hereditary and is unconnected with parathyroid deficiency, or with syphilitic infection. It is considered by most authors not to be due to an inflammatory cause but to be due to a derangement of the mineral metabolism [1, 2].

The following case of osteitis deformans is considered to be of interest on account of the youth of the patient.

Serjeant R., aged 33, shortly due for his release from the Army, was referred to the Surgical Outpatient Department of the British Military Hospital, Malta, on May 22, 1947, for investigation into the cause of " pains in his right leg " of which he had complained at infrequent intervals since 1933. He attributed the pains to the effects of a blow with a hammer on the front of his leg in 1931. From the onset of the trouble the pains seemed to occur after exercise and to subside with rest.

Previously the patient had not suffered any serious illnesses. In 1939 he had an attack of lumbago and sciatica which affected the right side more than the left. Up to 1942 he had several similar attacks but since then there had been no further trouble.

In 1944 he had a particularly severe bout of pain in his right leg below the knee after trying to catch a bus ; and about the same time he noticed that his garter was getting too tight, and was producing a deep red mark in his skin. He reported to his private doctor who arranged for an X-ray examination to be made at the local hospital. (We have unfortunately not been able to obtain a copy of the report from the hospital concerned.)

He enlisted in 1945 and was drafted in the Royal Engineers and when he reported that he was subject to " leg pains " was allowed a sedentary job and excused all heavy work.

After enlisting he complained of no further attacks of pain ; he was, however, conscious all the time of a dull ache in the right leg after even moderate exercise.

On examination it was found that the anterior border of the right tibia was thickened.

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No abnormality was seen or discovered in any other part of the body. On being questioned about his size in hats he admitted that for some months he had found it more comfortable to wear a larger-sized hat, but attributed this to a scar of a cut on the head which he sustained some time before.

Kahn test was negative.

Radiological Findings

Right A.P. There is an area of thickening in the cortex at the level of the tibial tubercle medially.

Lateral distinct area of rarefaction and thickening of the cortex in the upper half of the right tibia. The tibia is widened in this region approximately ¼ in. more than the left, and is bowed anteriorly. The lower end of the femur and the fibula are normal.

Pelvis: A large area of rarefaction is seen in the ala of both ilia, more marked on the right. The bodies of the ischia and the pubes are irregularly widened and show trabeculation.

Skull: Right lateral, there is a large transluscent area in the region of the temporal bone and the calvaria show marked thickening.

Spine: Cervical, the body of the third vertebra is wedge-shaped.

Dorsolumbar, there is no scoliosis present or kyphosis but the 12th dorsal vertebral body is rarefied and compressed in the centre.

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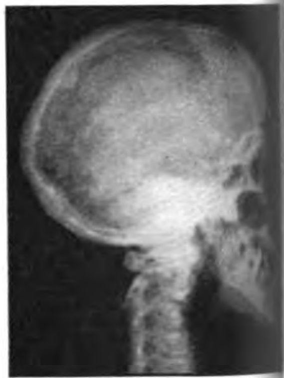
The radiological findings are typical of osteitis deformans (Paget's disease). The unusual feature is the age of the patient, and as there is considerable thickening of the skull structure it may be assumed that the onset of the disease is not recent. "The



disease rarely begins before the age of 40 and its commonest age is 55 . . . After the condition has been present for many years the calvaria become thickened and kyphosis occurs . . . [2].

Summary

An unusual case of osteitis deformans in a comparatively young subject is described. The radiological features of the case are discussed, and some of the skiagrams are reproduced to show the main points of interest.

In conclusion we wish to thank Brigadier W. D. Anderton, *M.C.*, D.D.M.S. Malta Command, and Lieutenant-Colonel J. E. Rea, R.A.M.C., Officer Commanding the B.M. Hospital, Malta, for their kind permission to publish these notes.

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NOTES FROM A.M.D.

Recent Successes

Three nursing officers of Q.A.I.M.N.S., Sisters J. S. Brooks, J. C. Otway and F. M. Bowring, have recently completed a year's T.B. Training at Baguley Sanatorium and have obtained the T.B. Certificate. All passed with distinction.

During the past two years eight nursing officers have obtained the London University Sister Tutor's Diploma—all eight passing successfully, six with honours.

Two nursing officers have completed four months' training at the Royal Eye Hospital and have received their certificates. To do this officers are seconded for four months having first had two months' experience in an Eye Ward of a Military Hospital.

Selected officers of Q.A.I.M.N.S. are given these special opportunities

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for training during their service in order to fulfil the wide professional commitments required for nursing in the Army.

Senior Appointments

The following changes in Senior Appointments have occurred or will occur in the near future :—

(*a*) T/Colonel R. Murphy from Connaught Military Hospital to Commandant, The Depot and Training Establishment R.A.M.C.

(*b*) T/Brigadier B. J. Daunt from Commandant, The Depot & Training Establishment R.A.M.C., to D.D.M.S., West Africa Command.

(*c*) Brigadier F. R. H. Mollan from D.D.M.S., West Africa Command, to D.M.S., B.A.O.R.

(*d*) Major-General Sir E. Phillips from D.M.S., B.A.O.R., to retirement.

(*e*) Brigadier T. Menzies from A.D.M.S., Aldershot District, to D.M.S., M.E.L.F.

(*f*) T/Major-General F. Harris from D.M.S., M.E.L.F., to D.D.G., A.M.S.

(*g*) Major-General J. C. A. Dowse from D.D.G., A.M.S., to Commandant, R.A.M.College.

(*h*) T/Major-General E. B. Marsh from Commandant, R.A.M.College, to retirement.

(*i*) T/Brigadier R. D. Cameron from D.D.M.S., London District, to Inspector of Training.

Retirement

We record with much regret the final retirement of Colonel Irvine Fortescue, *D.S.O.*, late R.A.M.C. He had 41 years of continuous service, the last 8 years of which have been entirely with the Polish Land Forces, acting in the capacity of their father confessor and friend.

CHRISTMAS GREETINGS FROM D.G.A.M.S. TO ALL RETIRED OFFICERS.

In previous years it has been a time-honoured custom to send Christmas Greetings individually to all retired officers of the Corps. In these times of austerity we have been particularly requested to economise in such Christmas Greetings, and I have therefore with regret decided temporarily to break with this ancient custom. This year I am therefore sending through the medium of the Journal my heartiest Good Wishes for Christmas and the New Year to all retired officers, wherever they may be. I sincerely hope that I will soon be able, once more, to convey my good wishes to you individually.

N. Cantlie.

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Review

TREATMENT BY MANIPULATION. By A. G. Timbrell Fisher. H. K. Lewis. 25s.

Like its predecessors this is an instructive and well-written volume.

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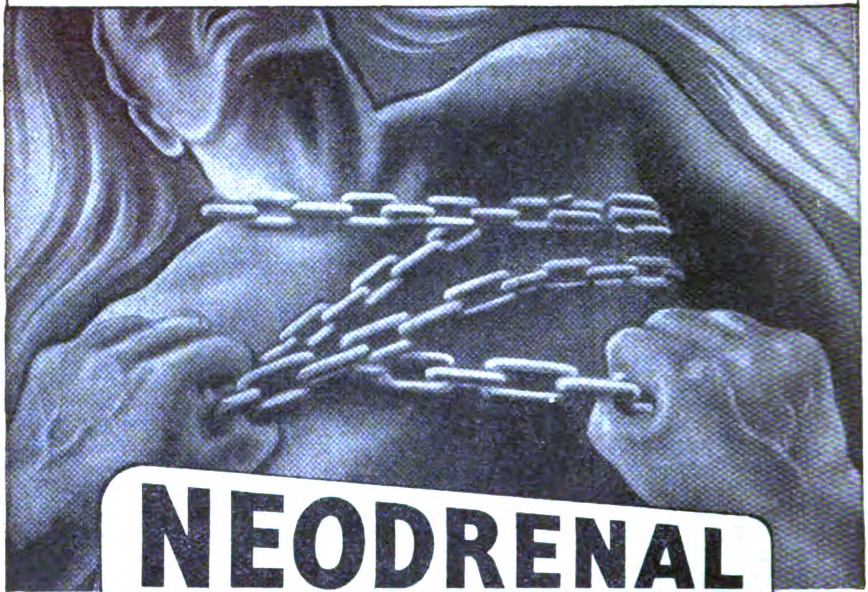

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BACKACHE AND SCIATICA IN THE ARMY

REPORT OF A DISCUSSION HELD AT THE CAMBRIDGE MILITARY HOSPITAL, ALDERSHOT, ON FRIDAY, APRIL 16, 1948

BY

Lieutenant-Colonel D. C. Mc. C. ETTLES
Royal Army Medical Corps
Officer i/c Surgical Division

IT is considered that the subject of Backache and Sciatica in respect of serving personnel is such an important one that it would be of general interest to Officers of the Corps if the papers read at this meeting were reported in full.

The chief speakers were :

Major J. S. Ellis, F.R.C.S., Surgeon i/c Orthopædic Department, Cambridge Military Hospital, Aldershot, Hants.

Mr. R. Young, F.R.C.S., Orthopædic Surgeon, St. George's Hospital.

Sir Charles Symonds, *K.B.E.*, M.D., F.R.C.S., Neurologist, Guy's Hospital.

Major Ian Roberts, F.R.C.S., Surgeon i/c Neurosurgical Unit, Military Hospital (Head Injuries), Wheatley, Oxford.

Captain Ian Macnab, F.R.C.S., Assistant Surgeon, Orthopædic Department, Cambridge Military Hospital, Aldershot, Hants.

Major Hedley Hall, F.R.C.S., Surgeon i/c Orthopædic Department, Cambridge Military Hospital, Aldershot, Hants.

Approximately 120 Officers and visitors attended the meeting which was opened by Lieutenant-Colonel Ettles, who introduced the speakers and outlined the object of the discussion, which was to answer a problem set eighteen months ago by Brigadier Fettes, *O.B.E.*, Director of Surgery, Army Medical Services. That problem being the assessment of the value of the operative treatment of backache and sciatica in the serving soldier. The operative work had been undertaken by Major Ellis and the results assessed by Major Hall.

Major Ellis opened the meeting, followed by Mr. R. Young and Sir Charles Symonds. After a short interval, Major Roberts presented the neurosurgical aspects of the problem. He was followed by Captain Macnab who indicated certain experimental work undertaken by himself at the Cambridge Military Hospital. Major Hall then reviewed the results of the Cambridge Hospital series. Major Y. D. Williams of the Orthopædic Department, Shaftesbury Military Hospital, also spoke briefly.

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The object of Major Ellis' opening paper was to stimulate subsequent discussion. It was therefore deliberately given in provocative style rather than as a series of factual statements.

Major J. S. ELLIS

BACKACHE is a common complaint and is frequently seen in an out-patient department such as we have here. Because of our work on prolapsed discs a large number of cases of backache are sent for investigation.

In common with pain of any sort backache is a difficult symptom to assess. We find that the effect on function, on the ability to do the work expected of him and on the man's enjoyment are more easy to gauge. Does it interfere with work ? With sleep ? With pleasure ? Do you play football ? Can you sit through the pictures ? These are the questions likely to give one an idea of what the symptoms mean to the man.

Backache, perhaps more than pain in many other parts of the body, seems linked with the functional element and with anxiety states. Many complaints of pain in the back are still diagnosed as functional which are due to a large disc prolapse. Any man who has pain in the back for long enough and continuously is likely to get neurotic about it and it is often difficult and always extremely important to sort out the relative proportions. Naturally it is also a fruitful field for the malingerer. If a man says his back hurts no one in the world can say it does not. In deciding when to advise operative treatment all these factors must be considered.

THE CAUSE OF THE PAIN

One of the greatest difficulties in the study of this symptom is that we do not know the origin and the cause of the pain. I feel that an attempt to discover the origin of the backache may assist in our interpretation of its significance. A number of theories have been put forward and several different structures blamed as the source of the pain. I would like to put the case for, or rather against, the zygo-apophyseal joints. Is it not possible that many types of backache may be due to malalignment of these joints ? What the *cause* is is a different matter and I do not understand how malalignment of joints causes pain. Muscle spasm and reflex nerve irritation have been blamed but it seems to me more likely that the pain originates from abnormal strains passing through ligaments that are being stretched through faulty alignment of joints or through weakness of muscles that no longer guard the ligaments. It is probably the cause of the pain in flat feet and in knee injuries so why not also in the back ?

If we once allow that the joints, both interbody and zygo-apophyseal, but especially the latter, are the origin of the pain many aspects of this subject become a little less puzzling. It explains the relief from pain on lying down: it explains why the bonesetters can often assist by manipulation (it is in fact *the* osteopathic lesion) ; it explains the pain that occurs in a case where there is a laminar defect even though no slipping of one body on another has occurred.

Patients with disc lesions will often say that the back pain came first and that the sciatica followed after an interval. Many will also state that when

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the leg pain came the back pain went. At first the swollen disc within the interbody space upsets the alignment of the zygo-apophyseal joints. When the disc, or part of it, degenerates and prolapses the joint alignment is readjusted and the protrusion causes sciatica from pressure on the root.

The other structure that many consider to be the origin of the pain is the posterior common ligament. This is said to contain nerve endings sensitive to stretching. This theory does not seem to me altogether to explain why pain occurs when the body collapses as in crush fractures or when the disc space collapses as in inflammatory conditions.

Differential Diagnosis

Leaving aside the intentional and hysterical types what are the causes of backache as we see this symptom in men of military age?

- Generalized spinal diseases
  - Scheuermann
  - Ankylosing spondylitis
- Inflammatory
  - Osteoarthritis
  - Tuberculosis
- Effects of fracture

  (Inflammatory, Osteoarthritis, Tuberculosis, Effects of fracture: Of spine and sacro-iliacs)
- Congenital structural anomalies
- Referred visceral
- Back strain. Sacro-iliac strain. Fibrositis
- Disc lesions

The differential diagnosis of the conditions listed here can usually be made on clinical and X-ray evidence. X-rays in antero-posterior and lateral positions are required. Lateral films must be true and carefully centred and it is sometimes helpful to have them taken with the patient standing up and lying down. In addition oblique views, with a 30 degree rotation, are essential for some conditions and more will be said about this later. The assistance that X-rays give in the diagnosis of disc lesions is mostly in excluding other conditions. I do not think there is any positive finding that is really useful except, perhaps, the appearance of reversed spondylolisthesis. This does, often I think, indicate a prolapse at that level. We have not used myelography, oil, air or oxygen, and it seems to have been largely abandoned.

Scheuermann's disease and ankylosing spondylitis seldom present great difficulties in diagnosis. Crush fractures can be seen in X-rays but before attributing pain in the back to such a condition it is well to be sure that the pain complained of is at the site of the fracture. If there is a kyphus, pain is often felt below the level, where a compensating curve is being upheld against strain and causing pain. It is no use fusing such a kyphus. The same may be true of the more gradual curve in the dorsal spine in adolescent kyphosis.

Pott's disease is encountered fairly often in soldiers, usually in a quiescent, healed stage. Osteoarthritis is seen sometimes in older patients but does not seem to be a common cause of pain localized to the back.

As for the congenital defects the problem is very difficult and Captain Macnab has something to say about this later. Anomalies in the anatomical arrangement of the low back are so common as almost to avoid comment.

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Lumbarization of the first sacral vertebra, sacralization of the last lumbar, spina bifida, changes in the planes of the zygo-apophyseal joints, laminar defects in the pars interarticularis, all these occur frequently in patients with backache. How often they are present in patients with no complaints we do not know. It seems to me that all these conditions are of importance in that they make the spine more vulnerable, more liable to trauma. Strains are allowed to fall on ligaments unfitted to withstand them.

When we get to a consideration of spondylolisthesis the position is a little clearer. Here, after all, is an obvious cause of backache. Zygo-apophyseal joints are malaligned, ligaments are pulled on, common ligaments are on the stretch. An obvious cause, too, of sciatica and, in fact, this is a condition that can give all the signs and symptoms associated with a disc lesion. In the soldier it is a surprisingly common condition. Gross cases like this are fairly rare but minor degrees of shift are not infrequent. As a rule symptoms only arise after trauma, although the anatomy has presumably been unchanged for years.

The visceral causes of backache do not come our way. In fact we have seen proved disc lesions investigated for ureteric stones. I believe it to be a rarer cause of backache than is generally stated, even in women.

Then there is the portmanteau; the last resort. "Back strain" is a diagnosis we try to keep as rare as "knee strain" but one, nevertheless, resorted to in despair. Sacro-iliac strains are not now in fashion. I have never been able to believe that this joint could be subluxated except in pregnancy or after major trauma. The minor degrees of subluxation after minimal trauma, or without trauma, which constitute the condition known as "sacro-iliac strain" I think are mythical. But we still diagnose it every now and then to keep an open mind!

Disc Lesions

And so we reach the disc lesions. At a Clinical Meeting here in the autumn of last year we showed some cases and briefly discussed the symptoms and signs of this condition and I do not propose to do so again to-night. I think it is impossible not to agree with Mr. Young that the disc lesion is the commonest cause of recurring attacks of backache with or without sciatica. There is absolutely no doubt about the condition or about the operative findings but whether the treatment is right is another matter. If something is causing symptoms from pressure on a nerve root it must be a good thing to remove it. It is difficult to believe, when an obvious prolapse is seen at operation, that any form of conservative treatment can bring about any lasting benefit.

It is a characteristic of this condition that remissions and exacerbations occur. These are responsible for some of the successes accorded to conservative treatment. The cause of the remissions is obscure. Sciatica may come and go as the result of varying the relative positions of root and disc. Dandy affirmed that the disc may prolapse and return to its normal position. Moreover alterations in the size of the protrusion may well be due to changes in the fluid content of the nucleus. Nuclear material removed at operation is

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strongly hygroscopic. It is well known that the turgor of the disc changes with age and it may be that œdema of the disc substance is the start of the events which cause retropulsion.

It is often seen that when trauma initiates an attack of pain there is a latent period between the trauma and the onset of pain. This cannot easily be explained if it is assumed that the trauma tears the annulus and allows the nucleus to prolapse but if the injury causes œdema of the nucleus or if some vascular disturbance brings about the same effect then a latent period would naturally precede symptoms.

Conservative Treatment.—The conservative treatment we have found most effective is strict bed rest. This may be successful because it allows œdema to settle down and also because it takes the strain off the intervertebral joints. The next method of treatment we have found useful is the plaster jacket. We do not apply this in hyperextension or under traction but simply with the man standing up as straight as he can. If there is gross scoliosis we change the jacket after a few weeks, but in point of fact we seldom treat cases with gross scoliosis by any conservative method. Allied to the plaster jacket is the lumbo-sacral belt. Both are effective methods of relief and I assume they are effective because they immobilize, to some extent, the affected part of the spine. It is difficult to get a man back to duty wearing a belt but much easier in the case of officers.

We are not very good at manipulating backs and often make them worse. I do not know why this should be but can only suppose that we do not do it properly.

In troublesome cases where bed rest does not relieve sciatica we have found that skin traction on the affected leg almost always does. A man in severe sciatic pain with 10 degrees of straight leg raising may be pain-free and able to lift his straight leg 60 degrees after a few hours' traction on the bad leg.

Some cases are relieved by novocain injections but our experience of this in the last year has been very small as we rarely find localized spots of tenderness or trigger points.

Operative Treatment.—At this hospital we have been trying to decide whether operative treatment should be undertaken in the serving soldier, and we have now had a chance to come to some conclusions. We have operated on 100 cases and feel satisfied that, with careful selection of cases, operative treatment should be done in the Army. A sufficient number of cases are materially benefited for it to be worth while. It must often be considered as attributable to service and the Army should assume responsibility. One of the troubles is that any man who has had a laminectomy can easily get out of the Army if he wants to. Certainly any man who has an untreated disc lesion is in the same position. The difficulty is to decide which men are going to want to get back and which are not. No back is normal for at least twelve months after operation and this should be clearly understood by the man. We never promise a cure and never press operation. We say " We think we can make you better. This operation is successful in about four out of five." More often than not the patient asks for operation.

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We operate under the following conditions :

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The decision to operate is often easy. Many of these cases are literally crippled and have been in bed for many weeks, grossly disabled. Our threshold is lower than it was at first but there are still cases that are difficult to decide upon. In these the social, domestic and military sides must be considered at least as carefully as the surgical.

It would be presumptuous for me to discuss operative technique with Mr. Young here, and neurosurgeons and orthopædic surgeons must not be led into championship of their rival methods. Here we remove the fifth lumbar lamina and the lower part of the fourth if necessary. We keep close to the mid-line and avoid interfering with the joints. We try to remove all the loose part of the nucleus and all that we easily can but we do not curette the space to reach bare bone. We try particularly to remove the nuclear material from the opposite side. We do not fuse the spine unless there is spondylolisthesis or a laminar defect.

There have been no deaths but we had one case that gave us great anxiety. This was a man who developed a persistent cerebrospinal fluid leak. We are most grateful to our colleagues at Wheatley for helping us with this case. Apart from this our only complication has been the occasional formation of hæmatomata. Major Hall will be saying something of the results of the cases we have all three done here and Captain Macnab will be discussing some experimental investigations.

Finally I should like to put a few questions in the hope that later speakers will give the answers.

To what is the pain due ?

To what is the scoliosis due ?

Is the sacro-iliac joint ever the origin of backache (excluding the inflammatory diseases) ?

Why do remissions occur in disc lesions ?

Mr. R. YOUNG

It is now generally accepted that the commonest cause of sciatica is a protrusion of an intervertebral disc. I think it is almost certain, although not yet proved, that intervertebral disc lesions are also responsible for nearly all cases of recurrent backache, and probably the majority of cases of chronic backache. That one has been slow to come to this inevitable conclusion has been due to the fact that until comparatively recently we had not operated on patients with backache alone, but only when it was accompanied by sciatica. In the last three or four years, however, we have operated on a number of patients complaining of backache only, and have found a lesion of an intervertebral disc in the great majority of them. The actual number

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of operations for backache alone is small relative to the number of operations for sciatica. This is because patients with backache only are seldom bad enough to require operation. They tend either to get better, or if they get worse, they usually develop sciatica. Further, 68 per cent. of our patients with proved disc lesions had had pain in the back alone as their earliest symptom, and the pain was limited to the back for months or even years before the sciatica developed.

Differential Diagnosis

Most of the chronic cases of low back pain not due to disc lesions can be diagnosed by routine radiography. Among the lesions that may be shown are spondylosis and spondylolisthesis, spondylitis (except possibly in the early stages), osteoarthritis, Paget's disease, old fractures, osteomyelitis, or growths, etc.

In my opinion the incidence of many other conditions which have been accused of causing backache has been unduly emphasized. I mean such conditions as sacro-iliac strain, lumbo-sacral strain, postural strain, post-pregnancy backache and fibrositis.

Postural strain may be a factor in some cases of backache, as for example in a patient with a lordosis below a kyphosis, but one very rarely sees it, or perhaps when there is gross cause for it, as sometimes in the later stages of pregnancy.

Post-pregnancy backache is said to follow relaxation of the ligaments particularly the sacro-iliac at parturition. This may be so, but where it persists one should expect it to be due to a disc lesion. We have had many cases of disc protrusions where the original injury undoubtedly occurred at parturition.

Fibrositis is a diagnosis that in my opinion should be viewed with the utmost suspicion. During the war we treated at Botley's Park a very great number of soldiers with so-called fibrositis said to be due to exposure to cold and damp. Most of these patients presented the typical picture of a protruded disc, and on more careful enquiry it was found that the patient was at the same time doing strenuous work in which he was likely to damage his disc.

At the Tank Testing Unit near us at Botley's Park an investigation into "tank back" revealed that 20 per cent. of tank drivers had backache which came on after driving tanks at speed over rough ground. These patients showed a typical picture of a protruded disc.

Clinically it seems to me that patients with backache fall into two groups. First, those with backache and definite physical signs; these will be found to be suffering from disc lesions, provided their X-ray is negative. Secondly, those without physical signs. In this group the backache may be due to a disc lesion, visceral disease or a neurosis. Visceral lesions should be excluded by a thorough routine examination. To distinguish, however, between a patient with a neurosis and one with a disc lesion without physical signs is extremely difficult and may require prolonged observation. Fortunately this latter group is an extremely small one.

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Congenital abnormalities such as spina bifida, sacralization of the fifth lumbar transverse process, and variations in the inclination of the articular faults are not, in my opinion, ever a cause of backache. Such abnormalities are, however, found more frequently in patients with disc lesions than in those X-rayed for reasons other than pain in the back.

It would appear that people with these congenital abnormalities are more likely to suffer from disc trouble than those without.

Cause of Pain

Dandy was right! Protrusions do pop in and out. Our first experience of this happened as follows:

We were endeavouring to dissect off an extremely adherent nerve root from an enormous protrusion which was pressing fairly firmly on the disc itself. Suddenly there was a slight noise like a cork coming out of a bottle and the protrusion disappeared inside the annulus. It was a nuclear protrusion type and no amount of manipulation of the patient could produce it again. We had to cut across the annulus in order to extract it from the depths of the disc.

Since then we have many times tried and succeeded in reducing protrusions —the annular tear often goes back with care—the nuclear protrusions rarely do so because they are usually like collar-stud abscesses. The annulus is often tightly shut down behind them thus effectively preventing their return. Further, some of the protrusions that one has been able to reduce can then easily be made to reappear, either by flexing the spine strongly, or by asking the anæsthetist to make the patient cough.

I think therefore that the origin of the pain in the back and leg can be explained most satisfactorily by variations in the size, shape and position of the disc, and its relative position to the nerve root.

Backache.—I believe backache is due to tension of the posterior longitudinal ligament and bulging of the annulus. It has been shown that the posterior longitudinal ligament and the superficial surface of the annulus is supplied by nerve fibres often derived from one to two segments higher. The type of protrusion we have found in those patients operated on for backache alone has either been a small "pealike" type, not large enough to involve the nerve root and being either lateral or medial to it, or a central protrusion which is sometimes fairly large, but not large enough to interfere with the nerve root or the theca.

Sciatica.—Sciatica is clearly due either to pressure on the nerve root by the disc—to stretching of the root over the disc—to adherence of the root to the disc—or any combination of these causes.

Remissions of the Symptoms.—Relief sometimes obtained from manipulation, and variations in the intensity of the symptoms afterwards, can all be explaïned satisfactorily on a simple mechanical basis. Thus the nerve root may slip off the summit of the protrusion and give relief from the sciatica for example, or the disc may actually reduce itself.

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Treatment

During the first attack we believe in resting the patient in bed for a minimum of two to three weeks. If there is no sign of any improvement then we advise operation. If, however, there is any improvement, we then persist in this line of treatment for much longer. In those patients with chronic pain or repeated attacks the decision to operate depends upon the severity of symptoms and the disability the patient has, having regard to his occupation. We believe it is a mistake to delay operation too long in the face of fairly severe symptoms and disability. If the protrusion is left too long it often becomes adherent to the nerve root and this makes the operation technically more difficult and the result more uncertain. There is also the point that these patients if allowed to persist with pain too long easily tend to become neurotic.

Latest Results of the Operative Treatment for Protrusion of the Disc

I am engaged at the moment in following up our patients operated upon for backache and sciatica since 1939, and so far I have succeeded in following up 443 patients with proved disc lesions. Of those patients with lesions at L.5, S.1 disc, about 80 per cent. are free of symptoms, and of those patients with lesions between L.4/5, 73 per cent. are free of symptoms. Results of the double discs are not quite as good.

Sir CHARLES SYMONDS

I agree with what Mr. Young has just said about disc lesions as the cause of recurrent backache. I think we have now reached a point at which we may say that sciatica may be assumed to be due to prolapsed intervertebral disc if no other cause can be found.

Twenty-eight years ago Sir Arthur Hurst had arrived at the conclusion that the only way to treat sciatica was by complete immobilization. Instead of sending his patients for physiotherapy, often involving repeated journeys by bus and tram, he ordered them to remain in bed and subsequently employed the plaster spica to obtain stricter immobilization with great success.

The pros and cons of conservative and operative treatment have given rise to much discussion and argument. Looking to past experience, that is to say, before the days of operation, it was true that patients with sciatica who failed to recover with conservative treatment were rare. In these days the pathology was regarded as inflammatory, and when the patient had recovered there was no argument for limiting his activities. He was therefore allowed to take active exercise and, as a rule, did very well. I know of many who played football and never had any recurrence. The question is when to advise operation. If a patient has made definite improvement with conservative treatment within three weeks it is worth going on with it, but it is very important to start with accurate observations of weakness, wasting, reflex changes and sensory loss, as well as straight-leg raising and—most important of all—the amount and severity of pain. If, for example, a patient before starting treatment is unable to cough without pain, and, at the end of a week, has lost this

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symptom, this is an important sign of improvement. If rest fails, or if there is rapid recurrence of pain after rest, operation—other things being equal—is probably advisable. I have myself given up plaster immobilization in favour of strict bed rest with injunctions to the patient to find out for himself which is the most comfortable position and stay there as far as he can. Another indication for operation is pain of a severity requiring morphia, persisting for longer than a week despite bed rest. These patients as a rule obtain immediate relief of their pain from operation.

Should a young person be operated on early or not? My experience has convinced me that a natural cure is better than a surgical cure, which involves a permanent alteration of the architecture of the spine. Therefore, I believe that conservative treatment should always be given a trial first.

In many cases that one sees to-day, though one may advise strict bed rest, the patient will say that it is impossible, and it is interesting to note that many of these patients do pretty well. Thus, of 73 patients I saw with sciatica in private practice in the past two years, 34 were unable to go to bed and were advised to avoid as far as possible all postures and movements which aggravated their pain and all made satisfactory recoveries, though probably in a longer time than would have been necessary if they had been able to go to bed.

In 15 cases I advised operation for one of the reasons already given. 24 patients had strict bed rest, which in 21 was successful. In the 3 others there was no improvement at the end of three weeks and operation was performed.

Of the 18 cases in which operation was done it was completely successful in 14 and in the other 4 partially successful, that is to say, there was still disability of some degree due to back or root pain.

Major I. ROBERTS

I HAVE been asked to give the neurosurgical point of view in the discussion of this very important problem of backache and sciatica. During the past year in the Neurosurgical Unit at Wheatley we dealt with more cases with this complaint than with any other single disease. Altogether I saw about 75 cases with this syndrome of low backache and sciatica.

ÆTIOLOGY

Generally speaking, as far as the neurosurgeon is concerned, a large number of the cases have been through the orthopædic filter before we actually see them, the result being that all those complaints with which Major Ellis has dealt have already been filtered out except the prolapsed intervertebral disc, and whether that condition passes through to us depends on the type of orthopædic filter.

The three main conditions causing backache and sciatica which we see at Wheatley are:

(1) Prolapsed lumbar intervertebral disc.
(2) Lumbar spinal arachnoiditis.
(3) Cauda equina tumour.

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Last year I saw 70 cases of prolapsed lumbar intervertebral disc, four cases of spinal arachnoiditis, one case of osteo-arthritis of the lumbar spine and one case where a pelvic tumour had infiltrated through the vertebral bodies to encroach on the cauda equina, all of which cases had symptoms of either backache or sciatica alone or more commonly low backache and sciatica together. There were no cases of cauda equina tumour but normally at Wheatley four or five cases are seen each year on the average.

As both lumbar spinal arachnoiditis and cauda equina tumour have to be considered in the differential diagnosis of sciatica I would like to spend a few minutes dealing with these conditions.

(1) *Cauda Equina Tumour.*—Love reported as many as 15 cases out of 100 operated on as prolapsed intervertebral discs where the lesion at operation turned out to be a tumour of the cauda equina. This seems to be a much higher incidence than one normally finds. The main points in the diagnosis of this condition are the nature of the symptoms, the characteristic distribution of the physical signs, the high protein content on lumbar puncture and finally the myelographic appearances. Even then it is often impossible to differentiate the condition from a large central prolapsed disc and the diagnosis is only made final after an exploratory laminectomy has been carried out. One case of massive protrusion of a disc in our series simulated a cauda equina tumour. This was an officer of 45 years of age who in 1935 had an attack of sciatica following exertion. In 1940 he had a similar attack which lasted about three weeks. During the next seven years he had one further attack till one month prior to his admission to Wheatley when the pain in his back recurred followed by bilateral sciatica. He was admitted into Colchester Military Hospital. A few days later he developed urinary incontinence, followed the next day by fæcal incontinence and sensory changes in the buttocks. L.P. revealed a complete block below lumbar 4 with the protein content of the C.S.F. 140 mg.%. He was transferred to Wheatley and at operation on the morning following his arrival it was found that a large piece of the disc (L.4–L.5) had extruded through the posterior longitudinal ligament and was compressing the cauda equina. This was removed. Immediately following the operation the sciatic pain disappeared, but it is only now, six months after the operation, that the bowel and bladder symptoms are showing signs of improvement.

(2) *Lumbar Spinal Arachnoiditis.*—This is an intrathecal aseptic inflammatory condition localized to the lumbar region. Generally speaking there has been a tendency to consider this condition as an entity in itself, but French (1946) reported that 13 out of 200 patients operated on as prolapsed discs were found at operation to have arachnoiditis, and of these 13, 8 had proven discs. The important point to realize is that arachnoiditis may be secondary to a prolapsed disc. Of the four cases diagnosed as arachnoiditis at Wheatley, only two came to operation. In one a moderate degree of prolapsed disc was found at operation and in the other the disc was normal but the root was very adherent to the posterior longitudinal ligament. Separation of these adhesions in the latter case produced immediate relief of the sciatic pain.

According to French the main feature is the acute onset of severe symptoms

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superimposed on a previous history of long-standing backache. These symptoms are generally pain in one or both extremities of a shooting, burning or cramping nature. Paresthesiæ are very common and muscular weakness may be present. Symptoms are bilateral in about 50 per cent. of the cases.

French suggests the following points are aids to diagnosis :

(1) The patchy and diffuse nature of the symptoms.

(2) Increase in the C.S.F. protein : 6/13 cases had raised protein, the highest being 630 mg. per cent.

(3) Myelographic appearances.

Seven of French's cases showed a complete block and in the other six there was a localized abnormality with a rugged appearance of the thecal outline.

(3) *Prolapsed Intervertebral Disc.*—The most frequent cause of low backache and sciatica of the cases at Wheatley was the prolapsed lumbar intervertebral disc and it is this condition with its multiple problems which is the centre of our discussion this afternoon. It is with some of those problems which I should now like to deal.

(i) *The Pain.*—As Major Ellis has mentioned there are two distinct types of pain : (1) Low backache which generally comes on first, and (2) sciatic pain which comes on later.

Contrary to his experience I have not found that the backache goes once the sciatica appears. Generally speaking the patients have said that the backache takes second place once the sciatica pain appears and when the sciatica undergoes its characteristic remission the backache remains to a lesser or greater degree.

Low Back Pain.—I do not feel competent to deal with the back pain, which is really an orthopædic problem, in the presence of so many able orthopædic surgeons, but I have the view that it is due in part to the faulty posture which results from the initial injury or succession of minor traumata and which has the effect of overstretching the various interspinous ligaments and intervertebral joints. It is when this faulty posture is corrected and the overstretched ligaments put at rest in a plaster jacket that the backache disappears in certain cases.

There is another type of severe backache which I have seen in two or three cases and which is associated with an intense muscle spasm of the sacrospinalis and quadratus lumborum muscles. In one case this type of pain occurred following operation, the operation producing immediate relief of the sciatic pain. But on the tenth day, while leaning out of bed, the patient, a Guards officer, was seized by the most excruciating back pain, his back became arched in a position of opisthotonus and the back muscles could be felt to be in a state of complete spasm. As long as the patient remained at complete rest the pain eased but as soon as the slightest movement was made, the pain and spasm returned. It was only after a plaster jacket was applied under general anæsthesia that he got relief. Is this type of pain due to acute muscular strain or to a reflex nerve irritation ?

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(ii) *Sciatic Pain.*—There are various theories as to the cause of the sciatic pain.

(1) *Compression of the nerve root between the ligamentum flavum and the prolapsed disc :* Naffziger (1936) stated that there is a sulcus between the ligamentum flavum and the intervertebral disc in which the introspinal roots lie and these roots are liable to compression by either one or other of these structures.

(2) *Adhesions of the nerve roots :* Dandy, who described the concealed disc, stated that these discs are too small to produce compression ; they probably produce their symptoms by becoming adherent to the nerve root.

In two of our cases simple separation of the adherent nerve root resulted in immediate relief of the sciatic pain.

(3) *Stretching of the nerve root over the protruded disc tissue :* McConnel (1940) in his excellent paper on the mechanism of sciatic pain asserts that though compression and adhesions play their part, the essential feature is the stretching of the intraspinal nerves over the portruded disc tissue. It is this constant state of stretching which accounts for the persistent pain : movements and postures which increase the tension aggravate the pain ; rest and postures which minimize the degree of stretching relieve the pain.

Recently I have been impressed by the little manœuvres which relieve sciatic pain. A patient lying in bed feeling an attack of sciatica coming on has been able to avert the attack if, while lying on the non-affected side, he hyperextends his back, extends his hips and knees and dorsiflexes his foot on the affected side. One too has noticed at operation when the affected nerve root is exposed that by changing the position of the operating table from that of flexion to hyperextension that this manœuvre causes a lessening in the tension of the affected root particularly in those cases where the protrusion lies lateral to the root. In one case this manœuvre not only relieved the tension but also caused the prolapsed disc to return to its normal position. As a consequence to these findings I have in those cases where conservative treatment has been indicated applied the plaster jacket with the patient in a position of hyperextension as for fractures of the lower dorsal vertebræ. In several of these cases the relief has been marked.

Personally I feel that tension of the intraspinal root whether it be due to the protruded disc material or to the adherent root, both of which prevent the free normal movement of the root, is the main cause of the sciatic pain.

Myelography

We at Wheatley have found myelography particularly helpful in the difficult case ; its use, however, as a routine measure has been found unnecessary. In the cases where recurrence of symptoms following operation has taken place, it is of great value in differentiating between further disc protrusion and acute muscle strain.

Treatment

In all cases we try the effect of conservative treatment before recommending operation except of course in those cases where there are indications for

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immediate operation, e.g. massive protrusion with cauda equina symptoms and signs. Our criteria for recommending operation are those laid down by Sir Charles Symonds.

It was my practice earlier on to explore only the disc space which we had decided was the cause of the symptoms but more recently because of the fact that I have been finding on numerous occasions more than one disc involved I have routinely been inspecting both L.4–L.5 and L.5–S.1 spaces. Murray Falconer in his series of cases found that 25 per cent had two discs involved but our incidence has not been as high as that.

Results

The immediate results of operation have been disappointing to a certain extent. Though the sciatica was relieved immediately in the majority of cases the backache was only partially relieved.

Of the 60 cases on whom operations were carried out, three had no relief of the sciatic pain immediately following operation and in four cases the symptoms reappeared within a few months of the operation.

The causes of the non-relief of the sciatic pain post-operatively were:

(i) Multiple Prolapses: This occurred in two cases and it was only after subsequent operation at other levels with the removal of further prolapsed discs that the pain was relieved.

(ii) Arachnoiditis: In one case where the presence of arachnoiditis associated with a moderate degree of prolapse had been confirmed at operation, a further period of rest in bed was required before the sciatica was improved.

The recurrence of symptoms was due to:

(1) Acute back strain in two cases.

(2) Post-operative adhesions of the intraspinal root previously involved by the protruded disc—one case.

(3) ? further prolapse of the opposite side of the disc originally involved—one case.

In only one of the four cases was a further operation required and in this case separation of the adherent root resulted in immediate relief.

The backache remains the problem. In only a very few cases did the low back pain disappear within the first month of operation. I personally feel that the prolapsed disc and the sciatica it produces are secondary phenomena; the primary factor is some postural defect or malalignment in the back which is either inherent or secondary to trauma. Laminectomy and removal of the prolapsed disc is not the complete answer. The final problem is an orthopædic one. What causes the back pain?

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SOME COMMENTS BY MAJOR Y. D. WILLIAMS

I WOULD like to put forward a case for conservative orthopædic treatment. This consists of a manipulation of the low back particularly lateral deviation, rotation, and hyperextension, but not flexion. Having done this a plaster spica is applied with full extension of the spine and hip, this is done by allowing the legs to hang with the patient on the seat of an orthopædic table.

I feel that cases should be treated as follows:

(*a*) "Medically," i.e. bed rest with a pillow under the lumbar spine and fracture boards for a period of three weeks. If there is no improvement particularly as regards flexion of the lower back, or if there is so much pain that the patient requires morphia for a week then

(*b*) A hyperextension manipulation, and a spica should be applied as above for a period of twelve weeks, followed by a period with a low belt if considered necessary. This often gives dramatic relief.

(*c*) If after this period there is no great improvement particularly as regards function in the lower back, I feel operation should be performed; and if there is considerable low back pain, and skeletal changes as described by Captain Macnab, the operation should be reinforced with a bone graft.

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THE PATHOGENESIS OF THE CLINICAL PICTURE IN SCIATICA

Captain I. MACNAB

It is now widely accepted that a large proportion of cases of sciatica are associated with a prolapsed lumbar intervertebral disc. There is, however, very little agreement on how a prolapsed disc gives rise to symptoms and signs. I thought it would be useful to discuss some of the experimental work we have done on this problem.

First of all—why do these people get backache? In this respect it is relevant to discuss spondylolysis. In this condition a defect occurs in the pars interarticularis on one or both sides (fig. 1). There is no agreement as to the ætiology of this lesion. It may be due to a lack of fusion between two centres of ossification on each side of the neural arch. No one, however, has convincingly shown that these double centres occur. It has been suggested by Galluccio, Roberts and others that these defects occur as a result of stress fractures, such as are seen in the foot, the tibia, the neck of the femur and the inferior ramus of the pubis.

In the short time that we have been looking for this lesion, we have seen several examples and agree with Roberts that the lesion occurs more frequently than we commonly suppose.

The reason why it is not more generally recognized is that the laminar

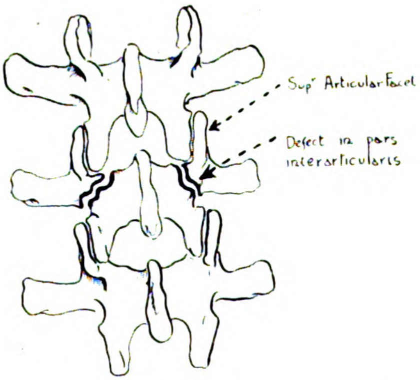

FIG. 1.

FIG. 2.

FIG. 1.—Diagram to show site of defect in neural arch in spondylolysis (the outline of the bodies of the vertebra have been omitted for clarity).

FIG. 2.—Oblique view of lumbar spine showing defect in pars interarticularis of the fifth lumbar vertebra.

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defect is not easily seen in the routine A.P. and lateral views but is only shown up convincingly on 30 degrees oblique views of the lumbar spine (fig. 2).

When the lesion is present, abnormal movements of the spine are permitted. The upper vertebræ may slip forwards on the one below it, as in spondylolisthesis, and, in addition, in flexion and extension there is an abnormal movement of the body of the vertebra in relation to the neural arch.

This is best demonstrated by a diagram (fig. 3).

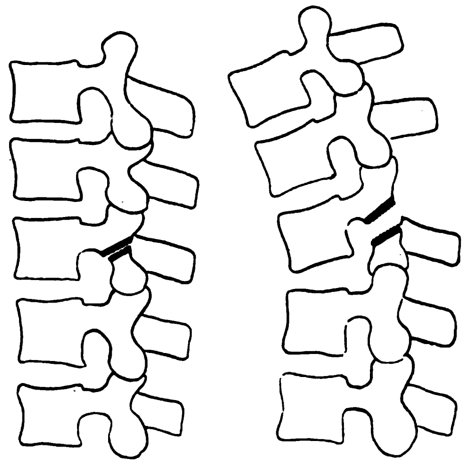

FIG. 3.—On flexion the two halves of the neural arch separate thus increasing the distance between the adjacent spinous processes. Any sudden unguarded flexion movement will thereby strain the supraspinous ligaments.

This type of movement puts an excessive strain on the posterior longitudinal ligament and ligaments in relation to the neural arch and, in particular, the supraspinous ligament. Kellgren showed that injection of hypertonic saline into the supraspinous ligament gave rise to backache and sciatica. Spondylolysis of the lower lumbar vertebra may likewise give rise to a referred sciatica on account of repeated strains of the supraspinous ligament.

In prolapsed lumbar intervertebral discs, there occurs a similar type of excessive mobility. The lumbar vertebræ are normally held apart by the turgor of the nucleus pulposus. When the nucleus prolapses, the distracting force is no longer present, the ligaments become lax allowing excessive movement of the vertebræ in relation to each other and resulting ligamentous strain.

In other words, some of the backache and sciatica associated with a prolapsed disc may be due to ligamentous strain. The other point arising out of this is the question whether cases of prolapsed disc associated with spondylolysis should have a spinal fusion performed in addition to removal of the disc.

PAIN IN THE LEG

Kellgren showed that injection of hypertonic saline into the supraspinous ligaments gave rise to sciatica and muscle spasm. Elliot, following up

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Kellgren's work, showed that the tender areas in the leg in sciatica were associated with local muscle spasm.

That some degree of muscle spasm is present cannot be doubted. Limitation of straight leg raising is due to a muscle spasm which is not abolished till the third stage of the third plane of anæsthesia.

Captain Sugden has given curare to two patients with sciatica. As the drug took effect, the pain gradually went and the straight leg raising was increased. The last case was of particular interest. After 15 mg. of curare were given by intramuscular injection, his straight leg raising increased from 30 degrees to 60 degrees but his pain was hardly altered. He was then given 5 mg. of curare by intravenous injection and following this he had difficulty in breathing, swallowing, and speaking.

Synchronizing with this change, his pain stopped, and his straight leg raising increased to 90 degrees. This suggests that there is a close relation between pain and muscle spasm.

Major Ellis has mentioned that with skin traction the patient can be relieved of his leg pain. We have found that coinciding with the disappearance of pain, the straight leg raising is increased. This suggests that traction cures pain by overcoming muscle spasm. In one case heavy traction did not relieve the pain, and it was discovered that the patient had placed a pillow under his knee. When the pillow was removed, and the traction allowed to stretch the hamstrings, by hyperextending the knee, the pain went.

That some degree of muscle spasm is present in these cases is certain, and I suggest that these observations indicate that some of the pain in sciatica is due to this spasm.

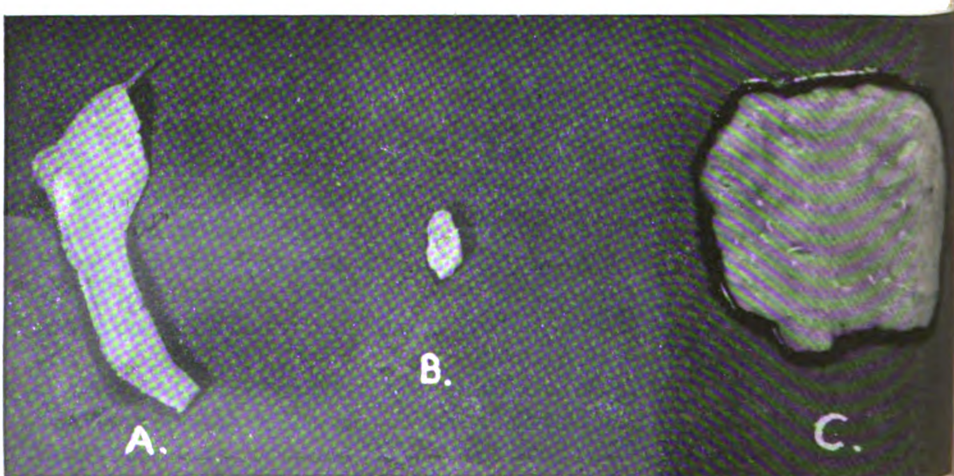

FIG. 4.—A portion of prolapsed nuclear material 0·4 c.c. in volume (equivalent in size to B.) was put in water for twenty-four hours and its volume then remeasured. It was found to have increased in volume to 3·8 c.c. C. An internal semilunar cartilage (A.) also left in water did not increase in volume.

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Periodicity

Another difficult problem in these cases is a history of periodicity. Mr. Young has told us that a prolapsed disc is capable of " popping " in and out, and this by itself would explain the periodicity. However, there is another possibility that must be considered.

Deucher and Love have demonstrated that discs removed at operation were frequently œdematous. We have shown that prolapsed nuclear material is remarkably hygroscopic (fig. 4). It is possible that a prolapse occurs, constant trauma produces œdema, the prolapsed material expands and symptoms are produced. Rest in bed, or local support, would allow the œdema to subside and the patient is temporarily relieved of symptoms.

Epidural injections of procaine, by breaking the local reflex arc, would likewise allow the œdema to subside, producing a remission of symptoms. A comparable lesion, as shown by Leriche, is seen in the ankle-joint, where the œdema following a strain subsides after infiltration with local anæsthetic.

In conclusion I feel that when considering the pathogenesis of the clinical picture in prolapsed lumbar intervertebral discs, we must consider the part played by ligamentous strain in the production of backache, the part played by muscle spasm in the production of pain in the leg, and the part played by œdema of the prolapsed disc in producing the typical history of remissions and exacerbations.

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REVIEW OF 93 LAMINECTOMIES FOR LOW BACKACHE AND CRURAL PAIN

Major HEDLEY HALL

TWELVE months is a short time in which to assess the results of treatment of patients suffering from a prolapsed intervertebral disc. The natural history of a man with a prolapsed disc is so unpredictable that the value of any form of treatment is difficult to assess until a large number of cases have been followed up for a number of years.

Our series of 93 cases have been observed at the longest for eighteen months ; at the shortest for a few weeks. Any conclusions therefore that we draw must inevitably be tentative.

Of the 93 laminectomies :

9 were performed on Officers.
8 were performed on Women's forces.
76 were performed on Other ranks.

Their length of symptoms were :

Less than six months	.. ..	10
Between six to eighteen months	..	37
More than eighteen months	..	46

A history of trauma was obtained from 28 per cent.

At operation :

Disc protrusions were found in 88 cases.
No disc protrusions were found in 5 cases.

Of these five :

2 were completely relieved by laminectomy
2 were found to have lamina defects and with the aid of a belt were improved. Neither of these cases was grafted.
1 is still under treatment with a partial relief of symptoms.

A questionnaire was sent to the first 50 cases to find the patients' estimate of relief obtained, capacity for work, and the persistence of symptoms. Thirty-four patients replied. The picture given by conning the tables is I think gloomier than in fact it is. For example, one man who could not guarantee more than four to five days a week was a miner working at the coal face. Another patient who suffered moderate back pain, whose back felt weak, had pain in the leg and who, although doing a full day's work had changed his previous work and given up sports, added as a postscript "What you did not ask ' Was I better for the operation ' ? Yes and thank God, etc. . . . who freed me from pain and let me enjoy my life once more." Although on paper disappointing there is little doubt as to the patient's view of the result. Of the 34 replies three only could be regarded as " perfect," i.e. were entirely free from symptoms, were doing a full day's work, had no recurrence of trouble since the operation, had not changed their work, nor given up sports.

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Of the remainder all had some disability, but this did not prevent 28 of them doing a full day's work. 25 had pain in the back of varying severity. 24 had pain in the leg.

Analysis of Replies

Pain in back	73%
Pain in leg	71%
Back feels strong	29%
Leg felt strong	41%
Vigorous leg movement in comfort	35%
Full day's work	70%
Returned to work less than 3/12	12%
Returned to work between 3/12–6/12	36%
Returned to work between 6/12–12/12	24%
Attacks of pain	61%

These results are disappointing in that so high a percentage have residual pain both in the back and in the leg. The most gratifying figures are the 70 per cent. who have returned to a full day's work in spite of symptoms.

The discussion was summed up by Brigadier Fettes who said that three points had been made:

(1) There was a place for the operation in selected cases. Probably these should be soldiers of the regular service.

(2) It was frequently an attributable disease.

(3) A valuable piece of work had been produced which was worthy of record.

He thanked all those who had taken part in the discussion. The meeting concluded with the showing of a colour film by Mr. Young in which the ætiology, pathology, operative technique, after treatment, and results of the operation for prolapse of the intervertebral discs were displayed.

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SPECIAL SERIES

We are reprinting in the next few Numbers a Series of Articles entitled "What Every Medical Officer Should Know About the Atomic Bomb."

These articles appeared in the *Bulletin of the U.S. Army Medical Department.* We wish to express our thanks to the Editor of the Bulletin—Lieutenant-Colonel Wayne G. Brandstadt—for permission to reprint these articles in full. They are a series of papers prepared by the Special Projects Division, Office of the Surgeon General, and based on material presented in courses on medical aspects of atomic explosion. It is unnecessary to emphasize the importance of this series.

WHAT EVERY MEDICAL OFFICER SHOULD KNOW ABOUT THE ATOMIC BOMB

I. Introduction to Nuclear Physics [1]

The atomic bomb has added a new terror and devastating force to the arsenal of war, and has increased the number of potential casualties which the Medical Department might be called on to handle in the event this weapon of destruction is employed in future warfare. National security makes it imperative that each Medical Department officer understand the fundamental facts regarding the medical effects of an atomic explosion. It is essential, therefore, that pertinent medical information on the problem be disseminated to those personnel who will be charged with the responsibility of caring for the sick and wounded resulting from the use of atomic weapons.

The electron. Units of negative charge of electricity, such as those used in any radio, electrons are produced by a hot filament in the tube elements. These electrons are evaporated from the glowing filament by the high temperature which is created in the filament. Careful measurements have shown that all of these electrons have the same physical properties. Furthermore, electrons produced from a glowing filament are exactly the same as electrons produced by other means, as, for example, by release from a photoelectric cell. The electron is the lightest particle known to man and weighs only 9×10^{-28} gm. The vast majority of all electrons found in nature are not "free" in the sense that they are not attached to something else, but are more or less tightly bound in a larger structure which is known as the *atom.*

The atom. An atom is the smallest part of a chemical element which enters into a chemical reaction. The concept of the atom as a structure which is mostly "space" is one which can be appreciated best by realizing the magnitude of atomic and nuclear dimensions. One gm. of hydrogen contains 6×10^{23} atoms. Thus, even if this gram of gas is contained in a very large vessel, the

[1] This is the first of a series of ten papers prepared by the Special Projects Division, Office of The Surgeon General, and based on material presented in courses on medical aspects of atomic explosion.

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number of atoms per cubic centimeter is extremely high. Each hydrogen atom has a diameter of about 10^{-8} cm., or less than one hundred millionth of an inch. All atoms are composed of an inner part called the *nucleus* and an outer part called the *electron shell*. The hydrogen atom is conceived as consisting of a tiny nucleus about which circles a single *electron*. This nucleus of the simplest hydrogen atom is called the *proton*. A proton is simply a hydrogen nucleus and is formed by stripping off an electron from the hydrogen atom. The proton occupies negligible volume inside the hydrogen atom, even though it constitutes almost the entire weight of the atom. Its weight is 1,840 times greater than that of the electron.

The electrical nature of matter. Electrons are the only particles that are found within the atom outside of the nucleus, and, since they are negligibly small as compared to the atom, it is clear that the greatest part of the atom is a void. Why then should the atom possess such apparent shape or rigidity which we know from experience it must have ? The reason for this lies in the electrical nature of the nucleus and of the electrons which speed about it in never-ending orbital paths. In every normal atom, the nucleus carries a positive charge of electricity which is exactly the same as the total negative charge of all the electrons within the atom. For convenience we call the charge carried by 1 electron $-e$ (it is actually 4.8×10^{-10} electrostatic unit). It is known that each electron carries a discrete electric charge of $-e$ unit. Each positive charged particle (proton) in the nucleus carries a charge of $+e$ unit. For any neutral (uncharged) atom the number of protons within the nucleus is exactly equal to the number of orbital electrons in the atom. Between the protons inside the nucleus and the electrons outside of it, there exists an electrostatic force which pulls the particles together. This force of attraction is just balanced by the centrifugal force caused by the whirling motion of the electrons around the nucleus. Thus the electrons perpetually gyrate around the nucleus in orbital paths through the frictionless void of the atom.

The outer part of the atom. Starting with the simplest atom, hydrogen with its atomic number 1, the number of orbital electrons is one. The *atomic number* (Z) of any atom is equal to the number of protons in its nucleus. For heavier elements, more and more electrons are found in the orbits. Helium with $Z=2$ has two electrons, iron with $Z=26$ has 26 orbital electrons, and uranium has 92 such electrons. These electrons arrange themselves in definite ways about the nucleus and obey rigorous atomic rules. Thus, they build themselves up about the nucleus in systematic shells that are peculiar in that each shell can contain just so many electrons. When one shell is filled, the electrons start another shell which is farther from the nucleus. The electrons which are in the outermost shell are called the valence electrons. These determine the chemical properties of the atom. Since these outer electrons are farthest from the nucleus, it is reasonable to suppose that they will not be bound so tightly to the atom. The outer electrons are in a sense shielded from the nuclear charge by the inner electron shells so they cannot "see" the nucleus. On the other hand, the electrons in the innermost or "K" shell are close to the nucleus and are thus most tightly bound to it.

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Ionization of an atom. If by some means we could pull one of the outermost electrons away from an atom, the resulting atom would no longer be electrically neutral but would have a net charge of +1. The process of removing an electron from an outer shell is called *ionization* and the resulting atom is called an *ion.* The combination of the positive ion and electron is known as an *ion pair.* An atom can be ionized by shooting high speed electrons at it. These minute projectiles may collide with some of the outer electrons and knock them out of their orbits away from the atom. From a medical viewpoint the ionization process is of tremendous importance, since it is the start of the process by which tissue suffers radiation damage. By bombarding an atom with very high energy electrons, it may happen that an electron in a "K" shell will be knocked out, forming a vacancy which is filled by one of the outer shell electrons. In this process energy is liberated from the atom in the form of an *x-ray.*

X-ray emitted from atoms. The emission of an x-ray from an atom always occurs when an electron from an outer shell fills a vacancy in a "K" shell. Because the electrons in atoms of different elements are bound to their respective nuclei with different energy, the energy of the x-rays given off will depend on the element which is producing them. X-ray tubes may have different elements for targets, and the rays emitted from a tungsten target are much "harder" than those from a copper target. The energy of radiation for x-rays is usually measured in electron volts. An electron volt is that energy which is acquired by an electron in being accelerated across a potential of 1 volt. In x-ray tubes the electrons emitted by the filament are accelerated by about 100 kilovolts, and we therefore say that these electrons acquire 100,000 ev (electron volts) of energy. X-rays sometimes behave as though they were "particles" and sometimes they act like "waves." In the literature, x-rays are often called *photons* or *quanta.* It is a fundamental rule in physics that every particle has associated with it certain wave properties and can be described as having a definite wave length. Wave length in the x-ray region is usually measured in terms of 10^{-8} centimeters or *angstrom units* (A°). If an x-ray photon has an energy of, for example, 1 million electron volts (1 Mev) it is said to have a short wave length or to be a very hard x-ray. On the other hand, if it is a photon of only .03 Mev it has a relatively long wave length and is said to be "soft."

The inner part of the atom. The nucleus of the atom, while it is a dense sphere taking negligible space within the atom, is composed of smaller units or particles. One of these particles—the proton—has already been mentioned, but little has been said about it. In addition to protons, every atomic nucleus except that of hydrogen, contains another type of particle—the *neutron.* The neutron differs from the proton in that it does not have an electrical charge. Both the neutrons and protons are about the same in weight and each is 1,840 times heavier than an electron. Therefore the bulk of all matter is found within the nucleus. If you as an individual were suddenly to be disintegrated so that the nuclei in the atoms of your body were free to come together, all your weight could be concentrated in a speck on the end of a pin. Because the nucleus has its components so closely packed together, we say that it has high density. Along with this close packing of neutrons and protons, there must be some

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force which acts between these particles. Particles inside the nucleus are called *nucleons.* This force which acts between nucleons and holds the nucleus together is a queer type of force which is called *nuclear force.* It is this force that is responsible for the enormous energy which is locked up within the nucleus. The energy is usually called the "binding energy" of the nucleus since it binds the nucleons together in a compact system.

Gamma rays emitted from the nucleus. When the nucleus of an atom suffers a collision with a high energy atomic particle, it may become "excited" by virtue of having absorbed energy from the collision. One way in which the nucleus can get rid of this energy is by emitting a photon. This photon is called a *gamma ray* and differs from an x-ray only in that it is generally a higher energy photon. Otherwise a gamma ray emitted by a nucleus is identical with an x-ray. Once a nucleus emits a gamma ray, it may return to its former unexcited or normal stage. Experimentally, many substances may be made to emit such gamma rays by irradiating them with a cyclotron beam or by placing them within a neutron reactor or pile.

Alpha and beta particles. About fifty years ago, it was observed that certain elements give off penetrating radiations. Elements such as uranium and radium give off a variety of radiations and are called radioactive elements. The phenomenon is known as *radioactivity.* Besides emitting gamma rays, these elements were observed to give off alpha and beta particles. *Alpha particles* are helium nuclei moving at high velocity. They are particles composed of two neutrons and two protons. Compared to an electron, such a particle is massive and might be expected to be easily absorbed in matter. This is actually the case, for most alpha particles are completely stopped by a few sheets of thin paper. This very short range of action for an alpha particle does not prevent it from being effective in damaging cell tissue. *Beta particles* are ordinary electrons which are emitted from nuclei. They move with high velocity (almost the speed of light) and are not as easily stopped in matter as are alpha particles. Beta particles of a few million volts energy will, however, be completely absorbed by several thin sheets of aluminum. Beta particles are created in the process of emission just as x-rays are created. Before emission, an atom does not contain an x-ray, and, in like manner, neither does a nucleus contain any electrons.

Radioactive transformations and isotopes. In the act of emitting an alpha particle, a radium (element 88) atom must undergo a change in its nuclear structure, for the two neutrons and two protons which make up an alpha particle are subtracted from it. Technically, we say that the radium atom undergoes a *radioactive transformation.* To facilitate an understanding of these phenomena, it is necessary to introduce some nuclear nomenclature. The radium nucleus is indicated by the symbol $88^{Ra^{226}}$. Here the superscript is called the *mass number* and is numerically equal to the total number of neutrons and protons in the nucleus. The subscript 88 is the atomic number or *charge* and is numerically equal to the total number of protons in the nucleus. Elements such as tin ($Z=50$) have a variety of different weights since some tin nuclei have more neutrons than others. These atoms of tin which have different

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numbers of neutrons are known as *isotopes* of tin. *Thus isotopes are simply atoms whose nuclei have the same atomic numbers but different mass numbers.* Some elements have only one isotope; whereas others may have as many as ten isotopes, each of which is present in different proportions.

When $88^{Ra^{226}}$ emits an alpha particle (symbolized by 2^{He^4} since it has atomic number 2 and four nucleons in its nucleus), it transforms itself into a new element known as *radon*. This reaction may be written : $88^{Ra^{226}} \rightarrow 86^{Ra^{222}} + 2^{He^4}$ (Radium goes to radon plus alpha particle). Analogous to chemical equations, it is possible to balance the equation and obtain a resultant atom of radon which has Z =86 and a total number of nucleons equal to 222. Instead of referring to this process as a radioactive transformation, we can also call it a *radioactive decay or disintegration*. The decaying isotope is the "parent" and the disintegration product the "daughter."

Radioactive series. Radium is only one of the many radioactive isotopes which occur in nature. Radium is itself the daughter of a thorium isotope which in turn is a daughter of a uranium isotope. There is thus a chain or series of isotopes that are respectively parent and daughter to each other. The radon that is formed from radium is also radioactive and decays to form polonium. and this forms an isotope of lead.

$$92^{U^{234}} \xrightarrow{a} 90^{Th^{230}} \xrightarrow{a} 88^{Ra^{226}} \xrightarrow{a} 86^{Rn^{222}} \xrightarrow{a} 84^{Po^{218}} \xrightarrow{a} 82^{Pb^{214}}$$

The *a* over the arrow indicates that an alpha particle is emitted in the decay process.

Lead is commonly thought of as a very stable element. By that is meant that it does not undergo radioactive decay. However, the isotope of lead that is formed in this radioactive series above is not stable. It has 214 nucleons in its nucleus, and since it must have 82 protons, there are 214–82 or 132 neutrons in the nucleus of this atom of lead. In the lead atoms found in nature the heaviest isotope is $82^{Pb^{208}}$. Thus the isotope $82^{Pb^{214}}$ is much heavier than the heaviest natural lead isotope for it contains six additional neutrons. Instead of emitting an alpha particle which would make the *neutron surplus* even worse, the lead isotope $82^{Pb^{214}}$ emits a beta particle, and the reaction is as follows :

$82^{Pb^{214}} \longrightarrow 83^{Bi^{214}} + -1^{e^0}$ (Lead goes to bismuth plus electron).

In this case, lead changes to an element of a higher atomic number, since the emission of an electron is equivalent to *adding* a charge of +e to the lead nucleus. In these nuclear reactions the electric charge is always equal on each side of the equation. Since the electron has neglible mass, the atomic weight of the isotope of bismuth is the same as the parent atom. By succeeding beta and alpha emissions the bismuth atom is finally transformed to a stable isotope of lead, $82^{Pb^{206}}$. This isotope is then the end of this series, which is called the uranium series. It must be remembered that in these decay processes penetrating gamma rays are also emitted; but, since gamma rays have no charge and no real mass, they do not affect the series relationships. In addition, two other naturally radioactive series are known—the thorium and the actinium series, both of which finally decay to stable isotopes of lead.

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The rate of radioactive decay. Does the radium atom, for example, disintegrate in one second or in one year? Actually the process is statistical in nature, and, if one were able to look at one isolated radium atom, one might see it decay in a minute or one might have to wait a million years for it to disintegrate. If, however, we look at 1 gm. or 2.6×10^{21} of radium atoms, we find that there is an average value for the time in which 50 percent of these atoms will decay. This time is called the *half life*, and for radium it is 1,590 years. If we start out with 1 gm. of radium, then in 1,590 years we shall have only 0.5 gm. on hand. Radium is said to be long-lived, but other atoms have extremely short half lives of the order of one-millionth of a second. Still others, like $92^{U^{238}}$ (the heavy isotope of uranium), are long lived, having a half life of 490.5 years.

In order to calculate the activity of any sample of a radioactive material, multiply the number of atoms present as follows:

$$\text{Activity} = \frac{(\text{No. of atoms})\ (.69)}{\text{Half life (in seconds)}} = \text{Number of particles emitted per second.}$$

The activity of 1 gm. of radium can be calculated as follows: 226 gm. of radium are equal to 6×10^{23} atoms. Therefore, 1 gm. contains 2.6×10^{21} atoms, and since the half life is 1,590 years or 5×10^{10} seconds:

$$\text{The activity of 1 gm. of RA} = \frac{(2.6 \times 10^{21})\ \ (.69)}{5 \times 10^{10}} = 3.7 \times 10^{10}\ \text{disintegrations/second.}$$

The unit of measure of this activity is the *curie*. The millicurie (mc.) unit is one-thousandth of a curie. A millicurie of radium gives off 37 million particles in one second.

The quantity of radiation. In treating a patient with radiation from a radium capsule it is necessary to measure the dose which is given. For this purpose the unit is the *roentgen* (r.), which is defined as that quantity of x-radiation which on passing through 1 cc. of normal air produces 1 electrostatic unit of ions. While it was originally defined only for x-rays, the definition is equally valid for gamma rays. A smaller unit, the milliroentgen (mr.), is often used in practice. The definition is perhaps not too meaningful because of the term—electrostatic unit—which is used. Physically, one should think of the definition as meaning that quantity of x-rays which is measured by a certain number of ions produced in a standard volume of air (roughly, 2 billion ion pairs per cubic centimeter of air).

Different types of instruments can be used to measure x-radiation. These are ionization chambers, Geiger-Muller counters, and photographic emulsions. One should sharply distinguish between those instruments that measure the dose or total quantity of radiation and those which give the dose-rate or the intensity of radiation. Dose is measured in roentgens, whereas dose-rate is measured in roentgens per second or in other time units. It is one thing to give a patient a dose of 1 r. of x-rays and quite another to expose a patient to a dose-rate of 1 r. per second. In the latter case, the patient receives a 1-r. dose in one second and a 60-r. dose in one minute. In one hour the patient would be dead or fatally injured.

Nuclear Fission and the Chain Reaction

We are now prepared to discuss nuclear fission. If by some process the compact atom nucleus can be split, it is known that part of the mass of the

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original nucleus will be transformed into energy. To appreciate this, we must discuss the mass-energy relation which was first put forth by Einstein.

The mass-energy relation. If in any reaction there is a decrease in mass of the reaction, Einstein's mass-energy equivalence law states that this mass is converted into some form of energy. The resultant energy may be evident in any of several ways. For example, radiation may be emitted as in gamma ray emission (radiant energy) or particles may be given high velocity (kinetic energy). In any event, $E = MC^2$ where E is energy released, M is decrease in mass and C is velocity of light. Let us assume that a uranium-235 atom ($92^{U^{235}}$) is split into two parts and that one-fourth of a mass unit is converted into energy. One mass unit has about the weight of one proton and is equal to 930 million electron volts of energy. One-fourth of a mass unit, then, amounts to about 230 Mev. Since the original $92^{U^{235}}$ atom weighs 235 mass units, it is equivalent to a total energy of 220,000 Mev. Thus only about $\frac{1}{1,000}$ of the total energy content of the uranium atom is released in this process. In fission, the greatest part of the 230 Mev of energy is released in imparting high velocity to the split atom parts (*fission products*).

A physical picture of the nucleus. In the foregoing, we have indicated something of the nature of the nucleus. We can form a very useful model or picture of the nucleus by thinking of it as analogous to a water droplet. Inside the confines of such a sphere, the neutrons and protons are in a constant state of violent motion, bumping into each other incessantly but always remaining inside the sphere. So strong are the forces between the nucleons that they pull each other tightly together and do not let each other out of "view." As evidence of this close packing of neutrons and protons inside the nucleus is the fact that the uranium-238 atom (the heaviest naturally occurring isotope) is only slightly larger in diameter than the nucleus of a light element such as aluminum. Outside the nucleus, the extremely strong nuclear forces are not felt because they have a very short range of action. However, the protons inside the nucleus make themselves known outside the confines of the nucleus by their electrostatic field. This field forms a barrier around the nucleus which prevents any charged particles from entering the nucleus. If, however, the particle which seeks to enter it is uncharged, it cannot "see" the particle and offers no resistance to its entry. For this reason, neutrons of low energy can easily slip inside the nucleus, whereas protons of even very high velocity are barred.

A model of the fission process. It is a property of a few very heavy nuclei such as U-235 that, when a neutron is added to them, they react very violently by splitting into two almost equal parts. The process is called *nuclear fission*, and the isotopes which exhibit this unusual behavior are called fissionable. The heavy products of the fission reaction, i.e., the two halves of the heavy atom, are known as *fission products*. We can picture the fission process by again considering the liquid drop model of the nucleus. Let us imagine that before the neutron enters the U-235 nucleus all the 92 protons and 143 neutrons are in constant motion inside the spherical nucleus. Let us assume that.

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because the nucleons are so close together and move so rapidly, they lose their individual identity and may be thought of as forming a fluid or liquid drop of uniform density. With the intrusion of a neutron into this balanced system, the liquid drop has energy added to it and becomes "excited." The particles inside the nucleus are set into more violent motion and the drop begins to lose its spherical shape. As it deforms into a nonspherical shape it sets up rapid oscillations that deform it still further into a dumbbell pattern. At this point the original sphere is essentially drawn out into two smaller spheres with a tenuous connecting link that then snaps. Then the two fission products shoot away from each other with high velocity. All this happens in an interval of less than 10^{-12} second and may be thought of as an instantaneous reaction.

Neutrons released in fission. When fission occurs neutrons are released. Over 99 per cent of these neutrons are emitted within less than 10^{-10} second, but a small fraction of 1 percent are delayed for as much as one minute after fission has occurred. All neutrons, whether prompt or delayed, are emitted by the fission products. In addition to neutrons, gamma rays, beta particles, and sometimes alpha particles are emitted in the fission process. A reaction equation for a fission process can be expressed as follows :

$$92^{U^{235}} + 0^{n^1} \longrightarrow 46^{Pd^{117}} + 46^{Pd^{117}} + 0^{n^1} + 0^{n^1}.$$

(Uranium-235 plus neutron gives 2 palladium isotopes plus 2 neutrons.)

This assumes that the nucleus splits into two equal parts. If one looks in a table of stable isotopes one finds that the heaviest natural isotope of palladium is $46^{Pd^{110}}$, while the palladium isotopes shown in the reaction equation are much heavier, having seven more neutrons per atom. From experience, we know that these abnormally heavy isotopes are not stable and must by some means make up for the abundance of neutrons in their nuclei. This can also be thought of as a deficit of protons in the nucleus. It is thus understandable that neutrons are so quickly emitted by the fission products.

Radiations from fission products. In natural fission it is rare for a pair of fission products to have the same mass, and it is much more common for one of the products to be heavier than the other. In general, there are two groups of fission products, one with an average mass of about 95 and the other of about 139. Fission products are intensely radioactive, emitting high energy beta particles and gamma rays. By emitting beta particles, the isotopes which contain too many neutrons (or too few protons) tend to make themselves more normal, since beta-emission is equivalent to changing a nuclear neutron into a proton. Because the fission products are born with such extreme neutron excesses, it requires four or five separate beta decays to result in stable atoms. Thus, each fission product is often associated with a chain of radioactive isotopes, and for this reason we speak of these as *fission chains.* Almost all fission products emit very penetrating gamma rays in addition to beta particles. The half lives for the various fission products vary from a fraction of a second to many years. The result of fissioning a large number of atoms is that we have an aggregate of many different fission products representing almost every element from atomic number 40 to 70.

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The chain reaction. If we wish to talk about the fission of large numbers of uranium atoms, it is necessary to have large numbers of neutrons available. Because the fission process requires only one neutron to initiate it and yet gives off between one and three neutrons per fission, it is possible to use fission neutrons to start a chain of fission reactions. Each fission adds more neutrons to the reaction so that more and more reactions are possible. Such reactions are called self-sustaining or chain reactions. Since the fission process occurs so quickly, it is conceivable that, if we were to assemble a certain "critical" mass of fissionable material such as U–235, we could set off a series of fissions that would proceed so quickly that the recoiling fission products and radiations would raise the critical mass to a multimillion degree temperature within a fraction of a second.' By definition, such a process would be explosive in nature. It is important to emphasize that the recoiling fission fragments that move with high speed cause the material through which they move to become hotter by kinetic collisions with other atoms. It is this heat caused by the motion of the fission fragments that causes an explosion to result. In like manner, if the energy is released at a slower rate, the heat may be tapped to be converted into power.

Prior to World War II, no pure U–235 was available. Ordinary uranium contains 140 times more U–238 than it does U–235. U–238 is not suitable for a chain reaction, because when it absorbs a neutron into its nucleus it merely changes into a heavier element without fissioning. Since the two isotopes of uranium are chemically identical, they can be separated only by exceedingly difficult physical methods. In fact, the methods presented so many technical obstacles that the Manhattan Project set up huge plants which used nuclear reactors running on natural uranium to generate a new man-made fissionable material—*plutonium* (Pu) (Z =94).

Plutonium. With neutrons released in the fission of the small amount of U–235 present in natural uranium, it was possible to sustain a chain reaction in a massive graphite-uranium pile. Under proper conditions a large number of the fission neutrons released in the pile can be absorbed by the U–238 atoms. This results in an unstable U–239 nucleus that rapidly decays by beta emission as follows:

$$_{92}U^{238} + {}_{0}n^{1} \longrightarrow {}_{92}U^{239} \longrightarrow {}_{93}Np^{239} + {}_{-1}e^{0}.$$

(Np is the symbol for *neptunium*.)

Neptunium is itself radioactive and soon decays to form an isotope of element 94 which has been named plutonium. Thus:

$$_{93}Np^{239} \xrightarrow{2.3d} {}_{94}Pu^{239} + {}_{-1}e^{0}.$$

The figure 2.3d over the arrow means that this reaction has a half life of 2.3 days. Plutonium is a dense silvery metal similar to uranium U–235 in that it is fissionable with neutrons which are of low energy. Like U–235 it is also an alpha emitter, and, since it has a half life of 24,000 years it is much more active than U–235, which has a half life of 7 x 10^8 years. The alpha activity of plutonium is sufficiently intense so that it constitutes a serious health hazard of about the same type as radium when it is deposited in bone.

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The concept of critical size. One of the unique characteristics of an atomic explosive is that it must be assembled into a certain critical size before it can explode. The reason for this unusual characteristic is that the chain reaction will not be self-perpetuating unless there are sufficient neutrons to cause continued fission. Suppose, for example, we wish to run a chain reaction at a rate of 500 fissions per second and that each fission generates exactly two neutrons. This requires that one out of every two neutrons generated be used to create more fission, so that we have to have 500 neutrons being used every second to cause fission. This leaves an additional 500 neutrons which we can afford to "lose" from our system either by absorption not leading to fission or by loss through escape from the system. When the number of neutrons being produced over and above those needed to keep the fission reaction going at a fixed rate is exactly equal to the number of neutrons lost from the system, we say that the system is critical, and this mass of material is called the critical mass. Masses less than this are called subcritical and larger ones are known as over-critical masses. The trick in detonating an atomic bomb is to make an assembly of fissionable material overcritical as fast as possible and keep it together long enough so that an appreciable fraction of the atoms are fissioned. If one simply stacked up subcritical blocks of U–235 until the assembly was overcritical, the chances are that no explosion would result. There would be a neutron "flash" and the heat generated by the fission of a small fraction of the atoms would push the blocks apart and make the assembly noncritical. The neutron flash would, however, be a source of danger.

The atomic bomb. A logical way to assemble an atomic bomb might be to take two hemispheres of fissionable material each of which is subcritical and bring them very quickly together to form an overcritical mass. One hemisphere of pure U–235 might be imbedded in a large mass of material placed at the target end of a gun barrel. At the other end of the barrel might be another hemisphere which serves as a projectile. Separated by the length of the gun barrel, each hemisphere would be subcritical and safe, but by firing the one hemisphere down the barrel, it would attain a high velocity and weld itself together with the target into an overcritical mass. The inertia of the projectile together with the force of the expanding gas behind it might hold the system together for an appreciable length of time so that a large amount of the uranium is fissioned. This might insure a high "efficiency" for the reaction. While it is not possible to calculate the exact magnitude of the activity associated with the radiations emitted by an atomic explosion without revealing classified information, it is possible to make crude calculations based on very simple assumptions. These show that the radioactivity which results from an atomic detonation is equivalent to more than 1 million tons of radium.

Radioactivity induced by neutrons. If a neutron strikes a nucleus of some element such as sodium, it may be absorbed or captured by it. This process is described by the reaction equation : $11^{\mathrm{Na}^{32}}+0^{\mathrm{n}^{1}}\rightarrow 11^{\mathrm{Na}^{24}}$. The resulting sodium atom is not normal and emits radiation. For this reason it is called radiosodium. Radiosodium emits a beta particle of 1.4 Mev and also a gamma ray. Thus, if an atomic bomb explodes close to sea water there will be a neutron-induced

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activity produced, since salt in the sea water is present to about 35 gm. per liter. Radiosodium has a half life of 14.8 hours, and for this reason the activity will persist for a few days before becoming negligible in intensity. Other elements can also be activated by neutron irradiation. This is the means by which carbon–14, radioiodine, and radiophosphorus are made.

II. Biological Effects of Nuclear Radiation From an Atomic Explosion.

THE discovery of x-ray by Roentgen in 1895 opened to the world the field of ionizing radiation. In 1896, natural radioactivity was discovered by Becquerel while studying the fluorescent effects of different substances. While working with uranium, he found that photographic paper was darkened, and the air adjacent to the salts would conduct electricity and discharge an electroscope. In 1898 the Curies isolated radium from pitchblende. It was soon after the discovery of x-ray that Becquerel noted the biologic effects of radiation on skin. He carried a vial of radium in his vest pocket and discovered a burn on the underlying skin. This was the first indication of a biologic hazard. In the next decade, radiation was used extensively as a therapeutic measure on almost every known disease and frequently with disastrous results. It was not until 1903 that evidence of the marked sensitivity of the blood-forming organs and the reproductive organs of animals sounded the first warning that other than skin effects were occurring. Since that time the use of x-ray and radium has been approached with appropriate caution. This is mentioned to show that radiation is not a new problem introduced by atomic explosions. The increased seriousness of the radiation problems, has, however, stimulated greater interest in studying the effects of radiation and especially the mechanism by which radiation produces biologic effects.

Mechanism of ionization. The radiations with which we are concerned are gamma rays, and alpha, beta, and neutron particles. The effect they produce on living cells is known as "ionization." A ray or particle strikes an atom within the cell, breaks off a negatively charged electron, and results in a positively charged atom which, with the negative electron, is known as an *ion pair*. It is the formation of the ion pair that produces the biologic changes in the cell. The different radiations act differently to produce ionization. Beta and alpha particles directly ionize by applying their kinetic energy in striking and dislodging an electron from the orbit of an atom. Gamma rays and neutrons must pass through an intermediate step. Gamma rays strike a free or lightly held electron and impart kinetic energy to that particle which, in turn, ionizes the tissue. Similarly, neutrons collide with nitrogen or hydrogen atoms in the tissue and strike off a proton which, as a secondary particle, ionizes the tissue. The end result in either case is the formation of ion pairs in the cell.

Before considering radiation effects, the quantitative unit of radiation must be understood. It is called a roentgen (r.) and is the quantity of x-ray or gamma radiation that will produce in 1 cc. of air, under standard conditions, ions carrying 1 electrostatic unit of electricity of either sign.

Generalities concerning biologic effects. Practically all radiation effects are

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either definitely injurious or of no value to the individual from the standpoint of survival or competition. Some injurious effects are permanent and some temporary. Injurious effects vary widely in their severity. Ionizing radiation produces not one, but many different effects, even on the same species or organism. Some effects of radiation may appear in the descendants of irradiated individuals. Injurious effects may be beneficial as in the treatment of cancer, a balance being sought between the beneficial destruction of cancer and the injurious effects to the surrounding healthy tissue. An interesting paradox is presented here. Although irradiation will destroy cancer, it will also, under some conditions, produce cancer, as in the skin from repeated dosage.

External and internal radiation. In external radiation the source is outside the body and the radiation must pass through the skin to produce effects. With an external source, the radiation effect may be stopped by removing the source, moving away from the source, or by interposing adequate shielding between the body and the source.

In internal radiation the source is taken into the body by ingestion, inhalation, or through a break in the skin. The fission products or other radioactive elements are then deposited in the various organs of the body, the most important being a deposition in the bones in proximity to the bone marrow. When radioactive material is fixed in the tissue, it is excreted very slowly and so remains a constant source of radiation bombardment within the individual. There is no known process that will destroy or neutralize the radiation source, and methods to increase the excretion of the fixed material are unsatisfactory. The only limiting factor, other than excretion, is the normal decay rate of the radioactive element.

Tolerance levels. Past experience in the clinical use of x-ray and radium and laboratory experience in nuclear radiation have developed a level of radiation that is considered safe to absorb over a long period. This has been set at 0.1 r. per day of gamma or an equivalent amount of the other ionizing radiations. In all industrial processes an effort is made to stay within this maximum permissible dose.

With regard to internal radiation, the goal is no absorption. Specifically, in plutonium work, 1 mcgm. fixed in the bone is sufficient to require complete withdrawal from radiation work for life. A historic example of internal radiation injury is the occurrence of bone cancer and death among radium dial painters. The tolerance dose for radium fixed in the bone is only 0.1 mcgm.

Lethal dose. The lethal dose is fairly well established, and current thinking places the minimum dose that will be lethal for 50 percent of individuals (L. $D._{50}$) at 400 r. and the L. $D._{100}$ at about 600 r. When we speak of 400 r. as being lethal, we are speaking of irradiation of the entire body or total body radiation. Doses up to thousands of roentgens may be given to a small confined area of the body without causing serious injury except to the exposed area. The long-term effects of radiations ranging from the tolerance to the lethal dose are still obscure and the subject of some concern.

Biologic effects in tissues. Many theories have been advanced to explain injury from ionization, but the mechanism is still unknown. Among the more

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common are: (1) some chemical exchange that interferes with the normal interchange between the nucleus and the rest of the cell; (2) changes in permeability of the cell membrane; (3) production of a toxic substance in the cell; and (4) changes in the intercellular environment. When and if the true mechanism is discovered, we shall have a more substantial basis for recommending therapy, dosage, and possibly protective measures.

A single cell consists of several microscopically distinguishable parts that differ in chemical make-up. Since, under most conditions, all these parts are irradiated simultaneously at random, it is not surprising that many effects may sometimes be observed in the same cell. Some of these effects, such as chromosome breaks, increased granularity of protoplasm, change in affinity for various stains, cytolysis, swelling of the nucleus of the entire cell, can be directly observed by various microscopic techniques. Less direct physical methods reveal other effects, such as changes in viscosity of the protoplasm, or in the permeability of the cell membrane. It seems probable that only a small fraction of the cellular effects produced has yet been observed. The complexity encountered in the observation of cellular effects is increased many fold when we attempt to observe or analyse the effect on the many-celled organism. Here we irradiate many different types of cells and tissues, each of which may exhibit its own pattern of effects. This becomes further involved with the possibility of a radiation effect on one tissue producing an indirect effect on others.

A latent period is frequently mentioned that is really a misnomer. It is the period that elapses between the time the tissue is irradiated and the effects manifest themselves. Obviously, this period is not latent, but one in which numerous successive changes are occurring, which eventually lead to observable changes. Concerning the nature of these intermediate changes we are in practically complete ignorance. The various body tissues are listed in the order of their sensitivity to radiation: (1) lymphoid tissue, bone marrow, lymphocytes, lymph nodes, and Peyer's patches; (2) polymorphonuclear leukocytes; (3) epithelial cells of the gonads, salivary gland, skin, and mucous membranes; (4) endothelial cells, blood vessels, and peritoneum; (5) connective tissue cells; (6) muscle cells; and (7) nerve cells.

Tissue responses to radiation. Concerning the sensitivity of tissues in general, the more primitive cells (leukocytes and reproductive cells) are more sensitive to radiation than highly specialized cells (brain cells). Whether the effect of ionization is direct, taking place within the cell, or indirect, resulting from alterations in the environment, is still a matter of conjecture. Both mechanisms may be active. The effect of radiation on extremely radiosensitive tissue is diminished when the tissue is subjected to decreased oxygen supply. Freezing definitely decreases radiosensitivity.

The recovery of damaged tissue depends on the dose absorbed and the type of tissue. Beyond a certain quantitative absorption of radiation, the cell will die regardless of type. The reversibility of any specific effect is dependent on reparative and regenerative properties of the tissue. Muscle, brain, and portions of the kidney and eye cannot regenerate. Repair results only in scar formation.

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Other tissues, such as blood forming elements, membranes lining body cavities or glands, depending on the dose, may regenerate and resume their normal functions; but tissues that have been damaged and regenerated may not respond after repeated ionization, which makes it imperative to avoid a repetition of the injury.

One of the peculiarities of radiation is the variation in response of the different species and between identical cells or tissues of the species to the same dose of radiation. Because of this characteristic, it is impossible to measure effects in terms of severity to a single specimen, and statistical methods of measuring must be applied. The most convenient way of measuring most effects is to set up as a criterion some occurrence that may be classified simply as present or absent, such as inhibition of cell division, failure to grow, or death. Graded doses are given to various groups of biologic subjects, and, after the exposed cells or organisms have been scarred, injured or uninjured, the percent of uninjured cells is plotted against the dose. This gives a survival curve. The term survival here denotes the ability to perform a certain normal act in spite or irradiation.

An example of species variation can be seen in the following figures. The doses of x-rays required to kill 50 percent of the animals were as follows:

Mice	500 r.
Guinea pigs	250 r.
Rabbits	825 r.

This species difference is unfortunate, because we need quantitative information concerning radiation effects on man; but we are unable to draw quantitative conclusions concerning man from the results of experiments on laboratory animals. Species variations reduce such conclusions to a semiquantitative status.

The response to the *rate of radiation* falls into three categories: (1) Many biologic effects with a given dose are the same regardless of the rate at which it is delivered. Some genetic effects fall in this category. (2) In some cases, a given dose produces greater biologic effects if the rate of delivery is decreased. This has been explained by postulating that during prolonged radiation radiosensitivity may increase. (3) In the remainder—about 50 per cent—of the biologic effects, the effectiveness of a given dose decreases as the rate of exposure decreases. This has been explained by assuming a decrease in radiosensitivity or a recovery factor. Most known injurious effects fall in this category, which is fortunate, since otherwise the daily tolerance dose would have to be set lower than it is at the present, so that it would be impossible for an injurious cumulative dose to occur in the maximum employment of an individual in the vicinity of sources or radiation.

The *distribution and penetration* of radiation will cause the biologic response to vary. To produce damage, the radiations must reach the vital tissues. Since alpha particles (heavily charged) are highly ionizing, they are about 10,000 times as effective as gamma rays, but the range of action is limited by their poor penetration (about 0.1 mm. in tissue). This eliminates alpha particles as an external hazard as they may be shielded out with a piece of paper or the

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skin, but when they are deposited internally in the bone marrow, severe damage because of their high ionizing ability results. Beta particles have a similarly poor penetration (about 5 to 10 mm. in tissue), but are also dangerous internally. Since they have a strong caustic effect on skin at short distances, they must also be considered among the external hazards. High energy gamma rays have a much less degree of ionization per centimeter of the distance they travel than alpha or beta particles, but their ability to penetrate and reach the deep tissues makes them a particular hazard in external radiation. Neutrons are also penetrating (depending on their energies), and their power of ionization is about five to six times as effective as that of gamma rays, which places this particle among the serious external hazards.

There follows a comparison of relative quantities of various qualities of radiation required to produce erythema, showing that the higher energy rays produce their ionization in the deeper tissues, and, in order to produce a skin effect, must be given in higher doses:

Radiation range	Exposure required to produce erythema
Grenz rays	100 r.
100 kv. x-rays	350 r.
200 kv. x-rays	600 r.
1,000 kv. x-rays	1,000 r.
Gamma rays (radium)	2,000 r.

Acute and chronic radiation. The acute must be separated from the chronic in any discussion of radiation injury. Acute injury results from large doses that produce clinically recognizable effects. Chronic injury results from doses ranging from the tolerance levels to about 10 r. a day. This is the subject of intensive research, but little data on man are as yet available. The results of animal experiments must suffice, because of the unsuitability of exposing human beings to this relatively unknown hazard. The most predominant effects expected of chronic radiation are shortening of the life span, premature aging, the production of malignancies; skin changes from beta, soft gamma, and x-rays; and genetic injury. In man it is said that radiologists and industrial workers exposed to x-ray show an increased incidence of leukemia. In mice, however, using doses ranging from tolerance to 8 r. a day, the latest reports indicate that the incidence of leukemia and lung tumor is not increased; when they occur, it is at an earlier age. The higher the rate of radiation, the earlier the onset. On the other hand, ovarian tumors do not depend on the rate of radiation, but on a minimal dose starting the process, the future course of which is not influenced by radiation. This minimal dose is cumulative, irreversible, and results in a higher incidence of tumors. Injury to mouse testes, however, is found to be reversible and only slightly responsive to cumulative dosage. Increased intensity of radiation over a short dose period will increase the damage.

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The above findings have not been given to confuse the picture, but to illustrate the variation in responses of different tissue and the difficulty of attempting to evaluate the chronic effects of radiation on man.

Blood. Observations of the blood count should reflect injury to the blood-forming tissues. This is true for severe overexposure. Alterations in the blood picture may be observed within an hour after total body radiation. There is an initial leukocytosis that is followed by leukopenia with a relative decrease in lymphocytes and, several days later, a reduction in the erythrocyte count. An anemia is a manifestation of severe bone marrow damage and is often fatal. For exposure to small quantities of radiation, the leukocyte count is not a reliable index. The daily normal variations, existence of low-grade infections, and variations in counting technique are among the factors reducing its reliability in measuring the relatively small variations to be expected. A count on an individual exposed to frequent radiation showing a reduction, even when compared to the individual's previously established normal, is not a positive indication of radiation injury. The only importance that can be attached to a slight reduction in count would be that seen in an individual who is a member of a group exposed to radiation in which all show the same variation. That would possibly indicate an overexposure to radiation for the group.

Reproductive organs. The elements of the reproductive organs that are injured by radiation are the progenetors of the mature germ cells and the genes that transmit the hereditary factors. Permanent sterility can readily be produced by exposure to about 800 r. in the male and 600 r. in the female. Temporary sterility may be produced by much lower doses.

Genetic injury. Genetics is a complicated and somewhat obscure science. Although genetic injury is especially important because the effects are produced by cumulative dosage without regard to dosage rate or wave length, little is known of the actual genetic effects to be expected. Its study is complicated by the long life span of human beings, the small number of offspring, the lack of knowledge of the specific dose received, and the difficulty of controlling experiments. Much of the information now available is the result of studying the fruit fly and various species of fish, the direct application of which to man is difficult.

In general terms, the gene is a germinal factor that carries hereditary characteristics. There are dominant and recessive genes. Recessive genes must be contributed by both parents if the characteristic is to appear in the offspring, while the dominant genes may be contributed by either parent or both. Mutations are changes from the normal within the genes and may be deleterious or beneficial to the race. Mutations may occur naturally or may be produced by radiation. Mutations in dominant genes may be detected in the next generation, while recessive mutations may go undetected for several generations. Since the majority of both natural and radiation mutations are recessive, little change can be expected in the first generation, and, being recessive, the probability that they will manifest themselves in a future generation is relatively small. In about 95 percent of mutations, whether spontaneous or radiation induced, the offspring will die during gestation or shortly afterward.

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Of the viable 5 percent, about 95 percent are deleterious, and, of these, about 96 percent pertain to other than sex chromosomes. The remaining are sex-linked mutations that are the exception to the general rule of recessives requiring generations for expression.

In Japan, the total dose received by the survivors of the atomic bombs of 6 and 9 August 1945 was very low for clear-cut genetic effects; but in the next twenty years, through the sex-linked mutations, a change in the male-female ratio may be seen. Ordinarily, more males are born than females, but radiation may cause a decrease in male offspring. The occurrence of defective offspring may increase the stillborn birth rate, and there may be an increase in infant mortality because of congenital abnormalities. All this is being studied in Japan on a long range program being planned by the National Research Council. Many years, however, will be necessary before significant results can be obtained and evaluated.

III. Medical Effects of Atomic Explosion

MEDICAL effects from the atomic bomb may roughly be divided into three categories: (1) trauma, (2) burns, and (3) radiation injury.

TRAUMA

Trauma was inflicted by the mechanical force of the explosion, either as blast or indirect trauma from flying debris. As in the case of the bombing of Britain, the latter was much more important.

Blast. The atomic explosion differs from an ordinary bomb blast in the extent of its range. No one was closer than several hundred meters to the bomb. At that distance the peak pressure must already have fallen, and its duration must have greatly decreased in comparison with what it was in the center. The explosion did not have the triphammer blow effect of high explosive, but was rather like a sudden violent gust of air that lasted for a brief but appreciable period. Japanese medical observers on the spot could not find any patients with direct damage to the internal organs caused by the blast. Necropsy of the early cases showed no evidence of blast damage to the lungs. Many persons reported having lost consciousness temporarily, with no history of direct trauma to the head. Observations tend to discount cerebral concussion resulting directly from the blast. A report shows a total of 17 ruptured eardrums at Hiroshima and 22 at Nagasaki. According to British investigators there is a great variation in the intensity of the blast pressure that will result in the rupture of the eardrums in man. In explosions where persons were subject to pressures of 45 to 100 lbs. per square inch, less than half of a small group suffered rupture of the tympanum. The drum may, however, rupture under pressures as low as 2 to 4 lb. in excess of one atmosphere (g). The acceleration of the pressure may also be important in determining the incidence of blast effects.

Indirect trauma. Windows were broken about 20 km. away. The radius of complete collapse of the natives' wooden buildings was around 2.4 km.

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almost symmetrically distributed about the center. The incidence of mechanical injury was about 60 percent between about 500 and 1,250 meters. It was only beyond about 2,700 meters that the incidence of mechanical injury in the survivors began to fall off rapidly, but even at around 4,500 meters it was 14 percent. Fatal injuries, however, were almost entirely in the zone of complete destruction. Those indoors in heavy buildings showed a higher incidence of injury than those remaining in native Japanese buildings, because the concrete buildings had more glass windows than those of the native type. This ratio of injury applied only to nonfatal injuries in survivors. It is assumed that the total mortality from immediate trauma was higher in the Japanese buildings than in the concrete buildings at the same distance, because over a wide area of impact the Japanese buildings collapsed from blast while the concrete buildings generally retained their structural integrity. Exactly how much of the total mortality was caused by the traumatic factor will never be known, because within one-half hour following the blast both cities were swept by fire before rescue operations could be instituted. Consequently, even though mechanical injury was not directly responsible for death, it probably contributed vitally to the actual mortality. This accounts for the low incidence of severe forms of injury among the survivors.

Types of injury. The distribution of injuries by type in a group of patients at a military hospital was (1) fractures, 11.5 percent; (2) contusions, 53.8 percent; and (3) lacerations, 34.7 percent.

Flying glass was the cause of most lacerated wounds. The fragments were so small that in many cases clothing was sufficient to protect the body. In one case, at about 1,000 meters, the patient was struck by glass fragments which, even though they did not penetrate his trousers, struck with sufficient force to pierce the skin of the upper portion of the bared torso.

Burns

The burns that occurred may be classified as (1) flash burns, which are the result of the direct action of radiant energy, and (2) flame burns. The latter were relatively rare, for the reason that it took some time, perhaps one hour as stated above, for the fires that were started following the blast to spread within the city. Consequently, those who did not escape were burned to death.

The radiant energy covered the entire width of the spectrum, which resembled that of the sun. Let us now consider only the ultraviolet, visible light, and infrared rays. None of these has a high degree of penetration, so that any solid object, such as clothing or foliage, was sufficient to produce a shadowing effect. Only surfaces exposed direct to the rays were affected by them, and as a result "profile" burns were common. The wood of dark-colored telephone poles was superficially carbonized at about 3,000 meters from the center. A temperature of 4,000° C. acting for 0.5 second is necessary to produce a second-degree burn. It appears that the injurious agents causing flash burns were of extreme intensity but of very short duration. Burns were remarkably common among those indoors, as it was summer and many of the windows were open. Burns were of no significance beyond about 4,000 meters. Beyond

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around 3,000 meters few burns required treatment. Of the deaths attributed to burns, 53 percent occurred within the first week and 75 percent within two weeks. Symptoms associated with the burns varied from case to case but tended to follow a fairly definite pattern. In individuals close to the blast, both burns and blisters were apparent in five minutes. In the vicinity of 1,500 meters, burns appeared in two hours and the blisters in four to six hours. Within about 2,000 meters, the burns appeared in about three hours and blisters after ten hours. In one patient at around 2,000 meters, however, there was vesiculation within ten minutes.

Effects of radiant energy on the eye. Direct injuries to the eye were remarkably few. Only a few palpebral burns were noted. The shadowing effects of the supra-orbital ridges and the blink reflex help to explain this finding. Almost all of the patients had temporary amblyopia that lasted for an average of five minutes. A few patients had conjunctivitis and keratitis. Only one patient with a permanent scotoma from perforation of the macula lutea was reported. Two patients suffered traumatic cataract following contusions of the eyeball. A slight reduction in the transparency of the cornea was observed in some, but they presented no subjective difficulties. One patient was so blinded by the flash that he was unable to distinguish light from dark for two days, but he made a complete recovery.

Keloid changes. Keloid changes appeared frequently and in many cases were extreme. According to Japanese physicians, a high incidence of keloids is not characteristic of their race, and they attributed it to the extreme temperature. It has been noted, however, that where skin flaps were removed for plastic surgery, healing resulted in keloid changes. Follow-up studies of this problem are being made by the National Research Council Committee on Atomic Casualties.

Pigmentation and depigmentation. Among the striking features of burns were the changes in pigmentation. At a distance of about 2,000 meters beyond center, the pigmentation, due to ultraviolet rays, was extreme and resembled a walnut stain, the "mask of Hiroshima." These burns were preceded by an intense erythema, which within a few days became increasingly pigmented. Surrounding the hyperpigmented area, a sharp border was seen in which was found a zone where there was even less than normal pigment. This zone represented an area where some melanophores had left to enter the hyperpigmented tissue. This pigmentation began to fade only in a few cases at four months and in many cases still persists. Depigmentation of the exposed skin caused by total destruction of pigment occurred at distances less than 2,000 meters. It was not necessarily associated with scarring of the skin. There was histologic evidence of loss of pigment in the basal layers, even though the epithelium of the surface was not destroyed. At the margins of the depigmentated zones there was found a narrow band of increased pigmentation external to which there was a vaguely defined depigmented border as described above. In the area of depigmentation the arrectores pilorum muscles were not damaged, since there was gooseflesh in these areas to the same extent as in the completely undamaged skin.

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Etiology of the burns. Certain features of the burns suggest the action of specific wave lengths, probably in the ultraviolet range. The intensity of the pigmentation at around 2,000 meters and, closer to the blast, the extreme depigmentation without destruction of the skin were certainly unusual results of thermal injury. It must be remembered that a relatively small quantity of air intervened between the patients and the bomb in comparison with the entire atmosphere and stratosphere that filter much of the ultraviolet from the sun. Gamma rays were not responsible for the sharply outlined pigmentary phenomena that have been described, since clothing would be no barrier to their action.

Protective effect of clothing. Clothing exerted a protective effect depending on a series of interrelated factors, including: (1) Distance. A khaki uniform, coat, and shirt worn together were protective beyond some 1,500 meters. Closer to the bomb, clothes were no protection. In some instances clothing actually caught fire and the resultant flame burns were among the most severe that were encountered. (2) Color and shade. Darker shades absorb more heat than lighter shades. The effect of selected absorption in many cases was remarkable. At about 1,600 meters, in the case of a white rayon shirt with a pattern of dark blue polka dots, 2 mm. in thickness and 1 cm. apart, the polka dots were burned in the line of the rays, but the intervening white material was undamaged. Extremely interesting was the effect on cotton cloth with flower pattern in a light pink background. The flowers were dark red roses with leaves of varying shades of green. Some of the flowers were entirely burned out, others showed only scorching of the darker portions of the leaves and petals, while the intervening material showed no effects. (3) Tightness. Where the clothing was more tightly stretched over the scapular and deltoid regions, burns were much more likely to occur. (4) Thickness and number of layers. The seams and double layer of the folded over collar demonstrated the protective effect of the thickness of clothing.

Radiation Injury

Skin. Epilation was frequently observed in persons who had been close to the bomb and who had survived for more than 2 weeks. At about 500 meters the incidence was about 75 percent and fell off sharply at about 1,250 meters. The time of the onset of epilation reached a very sharp peak between the thirteenth and fourteenth days after the bombing. The hair suddenly began to fall out in bunches on combing or general plucking, or it was found in considerable quantities on the pillow in the morning. This process continued for one or two weeks and then ceased. In most cases the distribution was that of an ordinary baldness, involving first the frontal and then the parietal and occipital regions, and sparing the temporal regions and the scruff of the neck. The eyebrows and even more so the eyelashes and beard were relatively resistent. In one group of patients coming to autopsy, 48 had epilation of the head, 8 of the axilla, 6 of the pubic region, 4 of the eyebrows, and 2 of the beard. Complete epilation is not necessarily correlated with a bad prognosis. Of all individuals who died of radiation effect at about the fourth week fourteen

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percent had no epilation. It can be assumed that they had received some shielding from concrete buildings or other sources, thereby filtering out the softer rays, and that death resulted from the hard penetrating rays that have little effect on the skin. Even in severe cases, the hair had begun to return by the middle of October and two or three months later had fully returned. In no case reported was epilation permanent.

Gastrointestinal tract. In many patients, severe nausea and vomiting occurred as early as thirty minutes following the detonation. In others it did not occur until the next day. Thirty-two percent of those within a radius of 1,000 meters and 23 percent at a distance of some 1,100 to 1,500 meters suffered from vomiting on the day of the bombing. The incidence fell sharply to 6 percent at about 2,000 meters. In many patients diarrhea, sometimes sanguineous, occurred within the first few days.

Testes. Histologically, radiation effects on the testes were discernible as early as the fourth day and were profound in all fatal cases in individuals who had been within around 1,500 meters of the bomb. Only three of the 23 patients studied who had been within about 1,500 meters had a sperm count in excess of 40,000 (lower limit of normal). Of 39 who had been within about 2 km., 13 had counts below 40,000. It is unusual for pregnancy to occur if the sperm count is below 40,000. Several of the patients complained of a loss of libido or even loss of potency following the bombing. According to Japanese physicians the return to normal has been slower in the male than in the female.

Ovaries. Histologically, the ovaries showed less striking changes than the testes. During the war years in Japan, there was a high incidence of amenorrhea, increasing from 4.3 percent in 1932 to 12 percent in 1944. In 1944, the incidence among 316 nurses of the Tokyo University was 13.3 percent. According to Japanese gynecologists, this was due to malnutrition, overwork, and anxiety associated with bombing. Thirty-six percent of the women in Hiroshima and 29 percent of the women in Nagasaki, between the ages of 15 and 49, who were within a distance of about 5,000 meters, experienced menstrual disorders. The majority of these had one normal period following the bomb and had cessation for an average of three to four months. A year later no patients were found complaining of menstrual disorders attributable to the bombing.

Purpura. In the skin, purpura was almost always manifested in patients dying in the third to sixth week, inclusive. Its incidence at various distances from the blast center ran almost exactly parallel to that of epilation and fell off sharply beyond around 1,250 meters. Purpuric spots appeared at about the same time as fever. Their peak was between the sixteenth and twenty-second day, about five days later than the peak of epilation. Associated with their onset, there was an increased tendency to bleed from lacerations, fractures, and burns. Healing of wounds was prolonged, coincident with the appearance of radiation sickness. The growth of granulation tissue stopped, and no tendency to heal was shown. In those who survived, the granulation tissue improved following recovery from radiation sickness associated with the purpuric spots on the skin. After the onset of the purpura of the skin, hemorr- ere also found in the gingivae and from the rectum, nose, urinary tract

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and respiratory passages in that order of frequency. The lungs were frequently involved in a necrotizing and hemorrhagic process.

Clinical Syndrome in Radiation Sickness

Patients who died within the first two weeks. In this group there was histologic evidence of radiation effects on the skin, gastrointestinal tract, lymphoid tissue, bone marrow, or gonads, but these have not been clinically manifested. There was no epilation or purpura. Patients complained of nausea and vomiting on the first day of the bombing, followed by anorexia, malaise, severe diarrhea, thirst, and fever. Death in delirium ensued. Profound leukopenia was present. Temperature records in all these patients were remarkably similar. Usually between the fifth and seventh days, and sometimes as early as the third day, there was a steplike rise in temperature, usually continuing to the day of death. The earlier the fever, the more severe the symptoms and the poorer the prognosis. The bloody diarrhea resembled that of bacillary dysentery.

Patients dying the third, fourth, fifth, and sixth weeks or surviving severe symptoms. In this group, the anatomic and clinical results of radiation attained their acme. Epilation and hypoplasia of the bone marrow were marked. The hemorrhagic and necrotizing lesions were comparable to those seen in aplastic anemia and agranulocytosis, and occurred in the gums and respiratory and gastrointestinal tracts. Petechiae of the skin were almost always present. The sequence of symptoms was as follows: In a typical severe case, the first evidence of the disease was nausea and vomiting on the day of the bombing, followed by a feeling of malaise. The patient then began to improve and felt fairly well until about the beginning of the second week when epilation began. A few days later he again experienced malaise and a steplike fever developed. At about the same time pharyngeal pain frequently appeared. Sanguineous diarrhea was a prominent symptom. The leukocytes and platelets reached very low levels, and a profound anemia was present.

In a third group in whom the bone marrow failed to recover, the symptoms described in the second group continued, and the patients died of extreme emaciation after a prolonged illness. In others, concomitant with partial or complete recovery of the marrow, most of the striking manifestations classed as anemia disappeared, but they succumbed to such complications as lung abscess and tuberculosis.

(*To be continued*)

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Clinical and Other Notes.

"OUR WILL AND PLEASURE"

A story of the "teething troubles" which led to the issue of the Royal Warrant of 1898

THE signature by Queen Victoria of the Royal Warrant of June 23, 1898, was the culmination of a long series of negotiations which had begun as far back as 1896. On April 21, among the voluminous correspondence received in connexion with our Golden Jubilee, there appeared in our postbag a letter from one whose name should surely be preserved among the great benefactors of the Corps.

Colonel C. H. Milburn, *O.B.E.*, *V.D.*, D.L., of Harrogate, when writing for particulars, after seeing in the Press a notice about the forthcoming Golden Jubilee, added: "I am interested as I believe I am now the sole survivor of the sub-committee of the then Council of the B.M.A., and also one of the deputation to Lord Lansdowne in 1898."

Little time was lost in getting into touch with Colonel Milburn and, with great good nature, he delved deep into many papers and after much trouble and research produced many documents of the greatest historic import.

We quote below from Colonel Milburn's notes which will be of great interest to our readers and of the highest importance to future historians of the Corps:

"To anyone interested in the origin and development of the R.A.M.C., I would advise the study of the Article on the 'Association and the Army Medical Service' in the 'History of the British Medical Association 1832-1892' (pp. 148–159) by Ernest Muirhead Little, F.R.C.S.

This shows that as long ago as before the Crimean War there had been difficulties and injustices for the Medical Officers in the Army. Many attempts had been made to rectify them as is shown in the following list of Minutes and Reports:

(i) Lord Herbert of Lea's Commission 1858.
(ii) Report of Sir Ralph Thompson's Committee 1878.
(iii) Report of Lord Morley's Committee 1883.
(iv) Report of Lord Camperdown's Committee 1889.

Deterioration, however, continued and reached such a pitch that, on October 23, 1895, the Parliamentary Bills Committee of the B.M.A. appointed a subcommittee of four members to consider certain grievances, to report, and, if necessary, "to get some member of Parliament to bring the matter up in the House of Commons."

The next step was taken when, on October 20, 1896, the Parliamentary Bills Committee "appointed a subcommittee to consider the question of advancing Army Medical Reform, consisting of Dr. Bridgewater, Mr. Geo. Brown, Dr. Ward Cousins, and Dr. C. H. Milburn."

On December 10, 1896, Dr. Gordon, the Chairman of the Sub-Committee, presented the Draft Report and a Memorandum to a special meeting of the Parliamentary Bills Committee.

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Dr. Gordon's name deserves to be remembered with special gratitude throughout the Corps. There is no doubt that it was his skilled and forceful pilotage which, after a long and stormy passage, beset by many storms, finally brought the ship of Army Medical Reform safely to harbour.

This report described in its "Part I," and in the fullest detail, "The Army Medical Service as it is." This part of the document in eight closely printed pages paints in no uncertain terms a gloomy picture of the disastrous plight into which the Army Medical Services were fast declining.

At the outset it laid down four conditions for success :

(i) The establishment must be sufficient.

(ii) The individual standard must be sufficiently high.

(iii) The organization and working must be as perfect as possible.

(iv) The conditions of service must be such as at least to preclude serious discontent."

The extent to which these conditions were being met were epitomized in the "Conclusion" which we quote in full :

"*It satisfies none of them.* In other words, it is at present in the most unsatisfactory possible condition. Justly discontented, with duties and responsibilities second to none in importance, but without the army status necessary for their proper fulfilment, exposed to hardships and dangers in excess of those in any branch of the army, yet without the military recognition which others receive ; with an undue amount of foreign service, with no opportunity for advancing their professional knowledge, or the slightest encouragement to do so, with an anomalous and disjointed organization between men and officers, and in face of indefinite postponement of reform, it is no wonder that the British Army Medical Service is on its way to extinction. It is impossible for anyone acquainted with this state of things to regard with equanimity the prospects of a great war. If such a calamity were to overtake us it is difficult to see how we could avoid the utter collapse of the medical arrangements. A spectacle of misery and mortality to equal which we must look back to the horrors of the Crimea would not be a matter for astonishment."

Part II of the report deals with "The Necessary Reforms." This is divided under sub-headings "A" and "B." "B" is concerned with certain administrative reforms such as reduction of foreign tours, study and ordinary leave, recognition and rewards for professional merit, while "A" tackles the problem of "Rank, Title and a Corps." Cogent arguments are brought forward in favour of consolidating the Medical Staff Corps and Army Hospital Corps in one Army Medical Corps in which officers should have the rank and status of officers in other branches of the army. The report ends with the following "conclusion" :

"Such, in brief, is the necessary reform. Such reform should not merely remove discontent and put an end to the unedifying spectacle of a squabble

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between the War Office and the whole medical profession, but would secure what Lord Roberts and many other distinguished men want, namely, the officering of the Medical Service with the very best stamp of medical men. Such men would then enter the army on the same footing as their brothers and cousins in other branches, would by their connexions with regiments acquire the military discipline and tone which they should have, and form those friendships which add so much to the happiness of a career. Reasonable tours of service at home and abroad would tend to maintain good health, while study leave and the prospect of professional honours would make them the thoroughly efficient body of men they ought to be, and confer an incalculable boon on the army at large."

After discussion and some amendments the report was adopted and it was resolved that the memorandum should be sent to Lord Lansdowne, the Secretary of State for War, and arrangements were made for a small but influential deputation to wait upon him if he would be willing to receive it. The deputation was not asked for.

It was on January 18, 1897, that the subcommittee met again. They now recommended that six copies of the report should be sent to every Medical School in London and the Provinces, Scotland and Ireland, asking that the Deans and Secretaries should draw the attention of those contemplating entering the Army Medical Service tc the report. Also, by April 3, 1897, copies of the report and its appendix, brought up to date, were sent to fifty of the leading newspapers in the United Kingdom.

At the end of 1897 members of the subcommittee received a notice to the effect that it had been arranged for a "deputation from the British Medical Association to meet the Secretary of State for War, the Right Hon. the Marquis of Lansdowne, to lay before him the views of the profession with regard to the position of the Army Medical Services, at the War Office, Pall Mall, on Thursday the 20th day of January next, at 3 o'clock in the afternoon."

The Deputation consisted of the following :

Prof. Ball (Dublin Univ. and Reg. Prof. of Medicine).

Dr. T. Bridgewater (Vice Pres. B.M.A.).

Mr. Geo. Browne.

Sir Geo. Duffey (R.C.P.Ireland).

Dr. R. Farquharson, M.P. (Chairman, Parliamentary Bills Committee, B.M.A.).

Surg. Maj.-Gen. Campbell Fraser (Ret'd.).

Mr. Fras. Fowke (Gen. Sec. B.M.A.).

Dr. W. Gordon (Member B.M.A.).

Dr. T. C. Griffith (Master Soc. of Apothecaries).

Surg. Maj.-Gen. G. L. Hinde (Ret'd.).

Dr. D. Macalister (Camb. University).

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Mr. N. C. Macnamara, F.R.C.S. (Vice Pres. B.M.A.).

Dr. J. W. Miller (Member B.M.A.).

Dr. J. W. Moore (Prof. of Practice of Medicine, R.C.S.Ireland).

Surg.-Gen. Sir J. Mouat, *V.C.*, *K.C.B.* (Ret'd.).

Prof. A. Ogston (Aberdeen Univ. and Reg. Prof.).

Dr. R. Saundby (President of Council B.M.A.).

Sir Thos. Grainger Stewart (Edinburgh University and President elect B.M.A.).

Sir Wm. Thompson (R.C.S.Ireland).

It was also arranged that the principal speakers should be: Sir Thomas Grainger Stewart, Mr. Macnamara, Prof. Ball and Sir William Thompson.

The deputation was very favourably received and the foundation of a Royal Army Medical Corps with army rank and military titles was announced by Lord Lansdowne at a banquet at the Mansion House on May 4, 1898.

So ended the long struggle for recognition and efficiency and it is well that all ranks in the Corps should be reminded of the great part played by the British Medical Association in shaping the destinies of the Corps which has played so large a part in the attainment of victory in two world wars.

Colonel Milburn, who is now 88 years old, has sent the Director-General the following message:

"As probably the sole survivor of the special committee on Army Medical Reform, formed in 1896 by the British Medical Association, to draw up a scheme for action by which to obtain the reforms needed to ensure a satisfactory medical department for the Army, and as a member of the deputation to Lord Lansdowne, the then Secretary of State for War, I would like to congratulate you on the achievements during war and peace, on the work done in the last fifty years by which probably millions of men and women have had their lives saved when suffering from wounds or sickness. Continue the good work! and God bless you all."

We are sure that all our readers would wish to send their salutations and thanks to one who has fought so doughtily on our behalf and to wish him many years of health and prosperity.

Notices

Sir Weldon Dalrymple-Champneys, Bt. M.A., D.M., F.R.C.P., D.P.H., will take office as Chairman of the Council of the Royal Sanitary Institute on October 1, 1948.

FIFTH INDIAN DIVISION

A Dinner Club has been formed. Particulars of Membership can be obtained from Lieutenant-Colonel C. B. Appleby, *D.S.O.*, Hon. Sec. 5 Ind. Div. Dinner Club, c/o Glyn, Mills & Co., Kirkland House, Whitehall, London, S.W.1. Addresses welcomed.

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MEDICAL HISTORY OF THE SECOND WORLD WAR

LIEUTENANT-COLONEL B. L. RAINA, I.A.M.C., Combined Inter-service Historical Section, Ministry of Defence, Simla, India, is responsible for preparing the Official Medical History of the Second World War covering all troops (including British) in India, Burma, S.E.A.C. and Indian formations. only, in the other theatres of War. He would be most grateful if officers now serving in the R.A.M.C., who served with any of the troops indicated above, would forward direct to him at the above address, their personal experiences and accounts of their campaigns, with special reference to notes on Organization, Administration and Clinical observations. Accounts and notes, however brief, would be of great assistance in the compilation of this history.

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1947—January, February, March, April and September. 1948—January only.

Reviews

ANATOMY. By A. D. Le Vay, M.S., F.R.C.S. English Universities Press Ltd. Teach Yourself Books. Published by Hodder and Stoughton Ltd. 1948. 299 pages. 172 illustrations, some coloured. Price 4s. 6d.

This book is well conceived, well produced and profusely illustrated. It is an excellent example of a manual designed for a student who is as the author says "without a body to dissect."

Its appeal will be to a wider public than the general reader whom it is intended to help. Its price is very moderate, and it is recommended as a sound manual for students of Nursing, Physiotherapy and Radiography in the Army.

D. C. B.

SURGERY OF THE COLON AND RECTUM. By Sir Hugh Devine, M.S.Melb., Hon. F.R.C.S.Eng., F.R.A.C.S., F.A.C.S., and John Devine, M.S.Melb., F.R.C.S.Eng., F.R.A.C.S., F.A.C.S. Published by John Wright and Sons Ltd., Bristol. 1948. 362 pages. 277 Illustrations, some coloured. Price 52s. 6d.

This is a first-rate book. The authors have drawn almost entirely on their large personal experience for the material, although they gracefully pay tribute in their preface to the influence of their teachers and their colleagues in the English-speaking countries.

There is an excellent section devoted to the Surgical Anatomy and Surgical Physiology of the Colon and Rectum, and this is followed by consideration in detail of the Innocent and Malignant conditions affecting the Proximal and Distal Colon, and the Rectum. Operative techniques and adjuvants are described, and the authors adduce reasons why a preliminary defunctioning

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operation will still have its place in colon surgery in spite of the advances made in sulphonamide therapy.

This book is well illustrated, and is confidently recommended to Military Surgeons. It should be in all Military Medical Libraries, and a study of the methods so clearly described will well repay Army surgeons.

The publishers are John Wright and Sons Ltd., and the production of the book is of the high standard and quality associated with the name of this firm. D. C. B.

A Handbook for the Identification of Insects of Medical Importance. Second Edition. By John Smart, M.A., D.Sc.London: Printed by Order of the Trustees of the British Museum. 1948. Pp. 295. Price 20s.

The preface to the first edition of this book indicates that it is written for medical officers, entomologists, and public health officers who may be called upon, especially in tropical regions, to pronounce opinions upon the identity of insects and other arthropods which menace the well-being and health of men. Apart from passing references to important New World species, the scope is limited to those of the Old World.

The reader is presumed to have an elementary knowledge of general entomology and a more particular acquaintance with medical entomology such as is taught in post-graduate courses of tropical medicine.

The introductory chapter gives an excellent account of the structure, development and life-history of insects, classification and nomenclature and zoogeography. The work of entomologists attached to the fighting forces during the recent war, particularly in the Near and Far East, is represented in the revisions which have been undertaken in the new edition, which contains a new table of malaria-carrying mosquitoes. The chapter on arachnids and the section on tsetse flies have been revised, and the work on fleas rewritten.

In addition to thirteen plates the subject matter is well illustrated, and there is an abundance of labelled figures indicating the morphological details described in the text.

We can safely say that interest in medical entomology aroused in the course of post-graduate study will be well sustained and furthered by the use of this work. For the purpose for which it is intended the book is admirable. J. B.

Cardiovascular Diseases. Their Diagnosis and Treatment. Second Edition. By David Scherf, M.D., F.A.C.P., and Linn J. Boyd, M.D., F.A.C.P. London: William Heinemann Medical Books Ltd. 1948. Pp. 743. Price 63s.

This book from New York, but with many of its roots in the Vienna school of cardiology associated with Wenckebach's name, appears as a second, more systematic and considerably enlarged edition. This may cause some disappointment to many with a warm regard for the original edition whose understanding of clinical cardiology owed much to the discussion therein on

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common bedside problems of practical importance which tend to be dismissed summarily in more systematic works.

The simple difficulties encountered daily figure prominently in the text. Examples of these as seen in the stress laid on the application of percussion in clinical examination and its importance " as long as X-ray machines will not fit into the doctor's bag," and in the discussion on the assessment of simple systolic murmurs. Other enlightening features the book affords include a survey given of the range of irradiation of autonomic reflexes in the production of symptoms, the heart in endocrine disorders including ovarian hypofunction and the female climacteric, and the case it advances based on electrocardiographic studies for the incidence of myocarditis in various common non-rheumatic infections. The requirements of therapy are given in detail which does not fail to include necessary instructions in the application of psychotherapy where this is necessary. The radiological aspects of cardiology are adequately represented. Detailed discussion of electrocardiograph in diagnosis is relegated to a second volume by the authors devoted to this subject. Many will find the value of the work much enhanced by extensive bibliographies given at the end of each chapter.

The book can be strongly recommended for the understanding, detailed knowledge and other assistance required in the management of cardiac cases which it sets forth in simple, pleasing style. J. B.

Clinical Electrocardiography. Third Edition. By David Scherf, M.D., F.A.C.P., and Linn J. Boyd, M.D., F.A.C.P. London: William Heinemann Medical Books Ltd. 1948. Pp. 435. Price 30s.

This book is complementary to the authors' " Cardiovascular Diseases. Their Diagnosis and Treatment," not only in supplying detailed descriptions of the electrocardiographic records found in various cardiac disorders but also in respect of subject matter, as it embodies much clinical material not dealt with at length in the major work. In presenting the rules and laws which form the basic groundwork of electrocardiography the authors emphasize the difficulties encountered in their application, and in their original preface they state that their work is not designed primarily for those beginning their study of this field. This should not deter anyone wishing to acquire guidance in electrocardiography from referring to it.

Following a statement of basic anatomical and physiological considerations, an excellent review of the normal electrocardiograph and its variations is given. In the remainder of the work the subject is approached on the basis of abnormalities in the individual parts of the tracing, followed by changes associated by various diseases including endocrine disorders. Rather less than one-half of the book is devoted to the disturbances of stimulus formation and conduction and is largely clinical. On account of this part of the work alone the book well merits the attention of those who require a reference work on cardiology. They will find the subject matter set forth so as to make easy and pleasing reading and supply all the requirements of ordinary reference. Bibliographies are given to meet the needs of a more exhaustive inquiry. J. B.

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MODERN SURGERY FOR NURSES. Edited by F. Wilson Harlow, M.B., F.R.C.S., with a Foreword by Sir Lancelot E. Barrington-Ward, K.C.V.O., F.R.C.S. London : Wm. Heinemann Medical Books Ltd. 795 pages. 430 Illustrations.

This is a most comprehensive and up-to-date book on all branches of modern surgery and surgical treatment. It is very well produced, containing excellent illustrations, and is recommended for those who are studying for their senior nursing examinations, and for every hospital library. E. M. W.

MINOR SURGERY. Third Edition. R. J. McNeill Love. 1948. Lewis & Co. Price 22s. 6d.

There is a wealth of information packed into the four hundred pages of this book. Perhaps, at times, too much is attempted. As the author points out in his preface, it is difficult to know what to include and what to omit in a book of this type. The chapters on minor surgical procedures, genito-urinary surgery, and fractures and dislocations are excellent. That on anæsthetics would appear to attempt too much in reviewing the entire field of anæsthesia rather than on concentrating on the more practical points of the more commonly employed methods. A printer's error in this section on page 399 (dose of scoplamine) should not go uncorrected. The paragraph on page 52 on ileus is quite valueless. There is no mention of continuous intravenous infusion or gastric suction in the treatment of this grave complication and the text gives no information of any practical help. There is no mention of the general employment of early ambulation as a factor in the prevention of post-operative complications. The section on head injuries is a disappointing one.

These comments should not, however, seriously detract from the general quality of this excellent little book. For Service doctors who may require a source of ready and easy reference this new edition is a concise and valuable guide which can be recommended with confidence.

The illustrations are excellent and the script is clear and well set out.

D. C. McC. E.

THE VENEREAL DISEASES. A Manual for Practitioners and Students. Second Edition. By James Marshall, M.D., B.S., M.R.C.S., L.R.C.P. London : Macmillan and Co. Ltd. 1948. Pp. xvi + 369. Price 21s. net.

The second edition of this manual, contains, as did the first, "all that the average medical officer needs to know about the subject." (*J. Roy. Army Med. Corps*, December 1944.) The lay-out remains much the same, except that additional chapters on the treatment of gonorrhœa and syphilis by means of penicillin, and a note on Reiter's syndrome have been added. The practical aspects of both diagnosis and treatment are very clearly explained and the sociological implications of the venereal diseases are well stressed. The teaching is, in the main, on orthodox lines. However, as regards the treatment of early syphilis by means of arsenic and bismuth, not all venere-

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ologists would concur in the opinion that it is " almost universally agreed that treatment should be continuous, without rest intervals in which neither arsenic nor bismuth is given."

The book is divided into the following four sections: Gonorrhœa; Syphilis; Other Venereal and Allied Diseases; and Technique; with appendices on the sociology of venereal diseases, and the special equipment required in their treatment. The illustrations are good, and the text is enhanced by good case-history examples.

This manual will continue to be of much value to those for whom it was written, viz. practitioners and students. It should also prove to be of considerable use to medical officers commencing the study of venereology.

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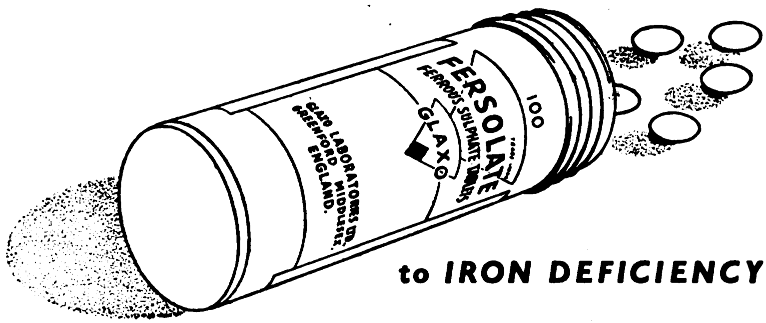

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Journal
of the
Royal Army Medical Corps.

Original Communications.

PARATYPHOID "B" FEVER
An Epidemic Remarkable for its Mildness

BY

Captain A. BATTY SHAW, M.A., B.M., B.Ch., M.R.C.P.
Royal Army Medical Corps
Graded Physician

AND

Captain R. P. C. HANDFIELD-JONES, B.M., B.Ch.
Royal Army Medical Corps
Graded Physician

IN December 1947 an epidemic of Paratyphoid "B" Fever occurred in a military unit in North Palestine. It is proposed to discuss the epidemiology, clinical features, pathology and treatment of the 40 cases admitted to a British military hospital. Twenty per cent of the unit were affected. The outstanding features of the epidemic were the clinical mildness of the cases and the positive blood cultures which were obtained at low body temperatures.

The reasons for the mildness of the outbreak are discussed, for the patients were not all completely protected by T.A.B. inoculation. The behaviour of paratyphoid fever in inoculated and uninoculated subjects is considered.

EPIDEMIOLOGY

The onset of the epidemic was explosive, as shown in fig. 1. The unit consisted of 200 officers and men living in huts and tents outside a small town. At the end of the month of November 1947 there had been an outbreak of gastro-enteritis in an Arab village 20 miles outside the town. Sixty-two civilians were involved and paratyphoid "B" was isolated from a number of the cases. Although the troops were largely confined to camp by the security regulations, it is considered probable that infection was conveyed from the village to the camp. Infected fruit or vegetables from the village might have escaped thorough cleansing in the cookhouse. An elderly Arab and two small Arabs

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ran a fruit shop within the camp, and Arab civilians worked in the cookhouse. It is possible that they may have carried the infection from infected friends in the town. The patients were honest and admitted that they bought fruit " over the wire " from unrecognized vendors ; the reason for this was the fact that fruit so bought was the cheapest. Finally, there were a number of flies in the area and it is possible that infected insects might have alighted on some food in the cookhouse.

The nature of the epidemic suggested that the source of the infection was the Other Ranks' cookhouse, since the Officers' and Serjeants' were not affected. It is probable that infection was confined to a single occasion with the exception of the last two cases.

The water supply was common to all the cookhouses in the camp, and was therefore not under suspicion. The cooks in the Other Ranks' cookhouse were admitted to hospital for examination of their stools and urines. One of them

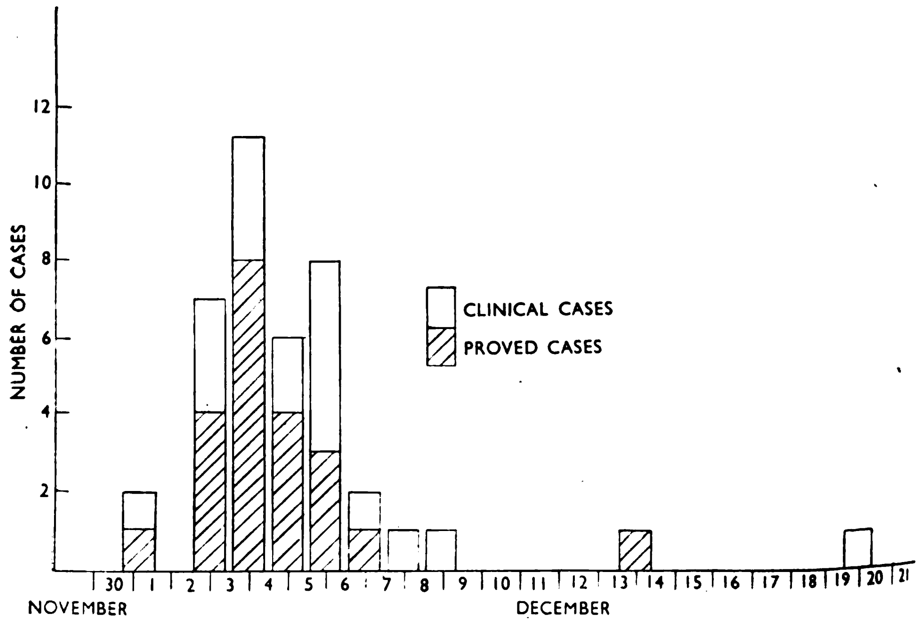

FIG. 1.—Incidence of cases.

developed a three-day fever five days after he was admitted. His case is reported in the section of Interesting Cases. Blood culture was positive on the first day of fever. The possibility that he was infectious in the incubation period was considered, but two specimens each of stools and urine were negative for paratyphoid " B " before he developed his fever. In no other food handler was paratyphoid " B " recovered.

SYMPTOMS

Forty cases were admitted, aged from 19 to 21, with from six months to two years' service in the Middle East. From 22 of these the organism para-

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typhoid "B" was recovered. The remaining 18 cases had symptoms which were identical with those in the proved group and were regarded as clinical cases. In the following description of the clinical features the total series (40 cases) and the proved cases (22) are treated separately.

Headache.—This was the presenting symptom in the great majority of cases; it was persistent and moderately severe. It was not so severe as is characteristically seen in typhoid fever. The site was frontal or retro-orbital in 20 out of the total series and in 10 of the proved cases; it was generalized in 10 of the total series and in 6 of the proved cases; the headache was occipital in 5 of the total series and in 3 of the proved cases. One proved case had headache confined to the right side and 2 of the proved cases had none.

Gastro-intestinal Symptoms.—That gastro-intestinal symptoms were prominent is shown by Table I.

TABLE I.—GASTRO-INTESTINAL SYMPTOMS

Symptoms	*Proved cases* (22)	*Total series* (40)
Anorexia	17	27
Nausea	13	17
Vomiting	4	6
Abdominal pain	12	20
Diarrhœa	4	6
Constipation	10	16

Anorexia was usually severe. The abdominal pain was mild, and consisted, in most cases, of epigastric or abdominal discomfort. In a few cases there were generalized abdominal cramps. One case was admitted with colicky pains in the right iliac fossa. There was tenderness and guarding at this site, simulating the picture of acute appendicitis.

Miscellaneous Symptoms.—These are enumerated in Table II.

TABLE II.—MISCELLANEOUS SYMPTOMS

Symptoms	*Proved cases* (22)	*Total series* (40)
Shivering attacks	20	33
Coryza	4	10
Backache	6	10
Epistaxis	5	7
Nightmares	4	5

SIGNS

Fever.—The fever was of low grade and of short duration. The temperature charts of 6 cases are shown in figs. 3 and 4. A not uncommon feature was for the temperature to settle to normal after three to four days in hospital and then to run between 99° F. (37·22° C.) and 100° F. (37·66° C.) for a few days.

In calculating the figures shown in Table III the total number of days is reckoned from the onset of symptoms and fever to the end of the pyrexial period inclusive.

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TABLE III.—DURATION OF FEVER

Days of fever	*Proved cases* (22)	*Total series* (40)
1	0	1
2	0	2
3	1	4
4	1	5
5	3	5
6	0	2
7	4	4
8	2	4
9	1	3
10	2	2
11	1	1
13	1	1
15	2	2
17	1	1
19	2	2
23	1	1

The temperature charts in the more prolonged cases were spiky and not like the usual sustained chart of typhoid. The chart of one who was febrile

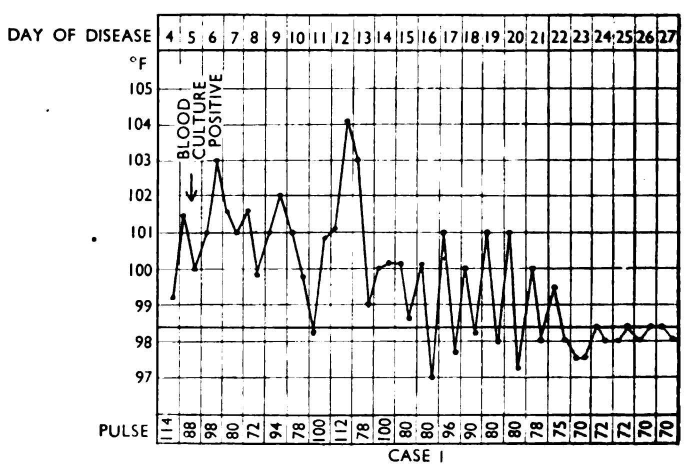

FIG. 2.—Temperature chart of Case 1 (L/Cpl. A.). This was the most severe case in the epidemic, and the best inoculated man among the 40.

for thirteen days, the longest in the series, is shown in fig. 2. The temperature of 6 of the milder cases that were confirmed by positive blood culture are shown in figs. 3 and 4.

It will be seen from the above table that 56 per cent of the cases ran a fever for seven days or less.

The highest temperature recorded in each case is shown in Table IV.

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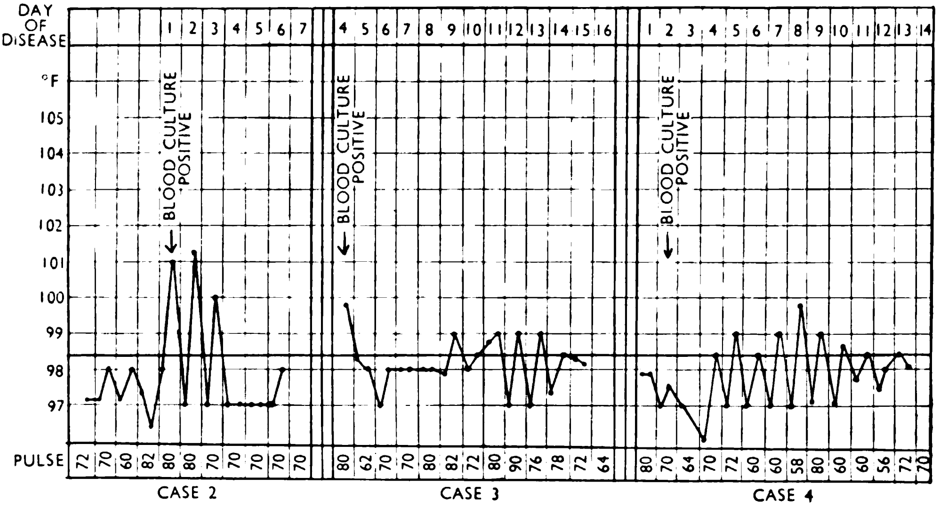

FIG. 3.—Temperature charts of Cases 2, 3 and 4. Note the short duration of fever in these cases, and the temperatures at which blood culture was positive. Cases 2 and 4 were fully inoculated with T.A.B. Case 3 had received one injection eight months previously.

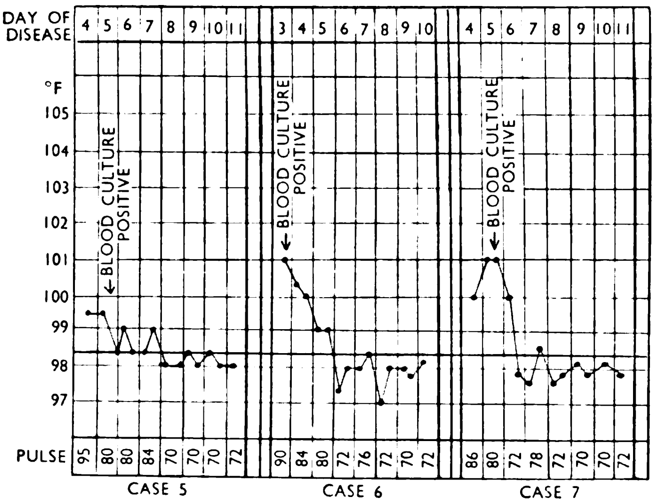

FIG. 4.—Temperature charts of three mild cases with positive blood cultures. Cases 5 and 7 had received a full course of T.A.B. inoculations. Case 6 had had 0·5 c.c. of T.A.B. six months previously.

TABLE IV.—HIGHEST TEMPERATURE IN EACH CASE

Temperature	*Proved cases* (22)	*Total series* (40)
99–100° F. (37·2–37·7° C.) ..	4	15
100·1–101° F. (37·8–38·3° C.) ..	7	9
101·1–102° F. (38·38–38·88° C.) ..	5	7
102·1–103° F. (38·94–39·44° C.) ..	3	5
103·1–104° F. (39·5–40° C.) ..	2	3
104·1–105° F. (40·05–40·55° C.) ..	1	1

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Spleen.—The spleen was enlarged in 13 cases (32 per cent), 10 of them being proved cases. It was usually soft and only just palpable, but in a few cases it was firm and easily felt. It was first felt on the third day in one case, the fourth day in 4 cases, the fifth day in 4 cases, the sixth day in 2 cases, the seventh day in 1 case, and the fourteenth day in 1 case.

Spots.—These were seen in 18 cases (45 per cent), of which 15 were proved by blood culture. They appeared as early as the second day of disease and as late as the twentieth. In most cases they appeared as crops of less than 6 spots at a time and up to 5 or 6 crops were noted in one individual. One man (Case 1) had over 50 spots on the tenth day of disease, and another had 15 spots on the thirteenth day. The spots were usually oval or circular in shape, and of about 5 mm. in diameter; some were triangular or flame-shaped. The usual sites were the front of the chest, abdomen, shoulder and upper arms.

Five cases showed one or two oval-shaped spots up to 8 mm. in diameter on the lower third of the extensor aspect of the forearm.

These were larger and more readily palpable than the characteristic rose spot. For the main part, spots were not profuse, but were pleomorphic and some of them not readily distinguishable from septic and sweat spots. The eruption of a spot and fading whilst under observation were regarded as the two most important diagnostic criteria.

Tongue.—Of the 40 cases, 19 presented a furred tongue with clean edges. Of these 19 cases approximately half presented the typical central clean furrow. It was noted that furring of the tongue was a persistent sign after the temperature had fallen to normal.

Complications

One case developed urethritis, with dysuria and hæmaturia on the fourteenth day. There were no cases of hæmorrhage, perforation, jaundice or venous thrombosis, and there were no deaths.

Pathology

The principle of early blood culture in all cases was adhered to. In spite of a low body temperature, paratyphoid " B " was isolated from 22 cases (54 per cent). The day of disease upon which blood culture was positive was as follows:

Day of disease	*Number of cases positive*
2	2
3	4
4	8
5	5
6	2

When blood culture was negative on the first occasion it was repeated two days later, in those cases who were still febrile; in none of these instances was the result positive.

The method of blood culture was to take 15 to 25 c.c. of blood into taurocholate broth and subculture on to MacConkey's plates after twelve hours.

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thirty-six hours', and four weeks' incubation. Any non-lactose-fermenting organisms were passed through sugars and then identity established by slide agglutination. All cultures were sent to the Army Central Pathology Laboratory, M.E.L.F., for confirmation.

When each case was afebrile 6 specimens of stools and urine were sent on alternate days for culture. In those cases, in which blood culture had been twice negative, the stools and urines were sent while the patient was still febrile. From one case urine on the fourteenth day contained paratyphoid "B," but no other specimens were positive.

Table V shows the temperature at which positive blood cultures were obtained. One of the interesting features of this epidemic was the low temperature at which organisms were recovered from the blood stream. The temperature charts of 6 such cases are shown in figs. 3 and 4. It will be seen in Table V that 7 cases had paratyphoid organisms circulating in the blood stream while their temperatures were below 100° F., and that the organisms could be detected by routine culture. The temperature of one victim was subnormal at the time that blood was taken for culture, and the result was positive, *vide* the Chart of Case 4 in fig. 3.

TABLE V.—THE TEMPERATURE AT THE TIME OF BLOOD CULTURE IN THE PROVED CASES

Temperature	*Number of cases* (22)
98·0° F. (35·55° C.)	1
99·0–100° F. (37·2–37·7° C.) ..	6
100·1–101° F. (37·8–38·3° C.) ..	7
101·1–102° F. (38·38–38·9° C.) ..	6
102·1–103° F. (38·94–39·4° C.) ..	2

The Widal reaction was not routinely employed since its results are often unreliable in inoculated personnel. White counts were not done as a routine. In the possible case of appendicitis a white count was performed and showed a leucopenia.

At the time of the epidemic the Pathology Department was busily employed with duties consequent upon an outbreak of terrorism and it was necessary to reduce our pathology commitments to a minimum.

TREATMENT

The standard principles of enteric fever treatment were employed, viz. bed-rest, fluids, good nursing and an adequate full calorie diet of suitable food; roughage was avoided and meat was minced but otherwise there were few restrictions. After two days in bed the great majority of patients had no subjective complaints of malaise, and the problem of keeping their bodies and minds at rest was a great one. The difficulty was to prevent them making more than a moderate amount of noise rather than to have to support their morale.

During the first week of the epidemic a complaint was received from the Serjeants' Mess, in an adjacent building, that the patients singing disturbed them. All were kept strictly in bed for at least two weeks after the temperature was normal, followed by a slowly graduated period of convalescence.

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Clinical Account of Selected Cases

Case 1.—Aged 20. (His temperature chart is shown in fig 2.)

On December 20 this man developed " shooting pains " in the forehead and on the next day lost his appetite, felt sick, had shivering attacks and was constipated. He was admitted to hospital on the fourth day of disease. His temperature was 99·4° F., and pulse-rate 70. Examination revealed that he was drowsy and lethargic, though his condition at no time gave cause for anxiety. The spleen was enlarged and firm, but there were no other signs apart from rhonchi in the chest. His temperature rose to 103° and 104° F. and remained elevated for twenty-three days before settling to normal. From the seventh to ninth days there were crops of 5 to 6 rose spots, and on the tenth day a profuse eruption of over 50 spots appeared on the front of the chest and abdomen, and on the upper arms and shoulders. A few spots appeared daily until the fifteenth day.

Blood culture was positive on the fifteenth day.

His dates of inoculation were as follows :

8.6.45, 23.6.45, 13.5.46, 12.5.47, 21.11.47.

He was the most severe case in the epidemic. It was interesting that he was the best inoculated man of the 40.

Case 2.—Aged 21. (Temperature chart in fig. 3.)

This cook was admitted on December 8 for investigation as a possible carrier. He gave a history of attacks of diarrhœa in the past. On admission he felt well, but five days later he developed a malaise, frontal headache, coryza and epistaxis. Blood culture on the second day of malaise grew paratyphoid " B." His fever lasted for three days. There were no rose spots and the spleen was not felt.

Inoculation State : 30.12.44, 9.2.45, 16.6.47.

This case was of the greatest interest as he developed his disease while he was in hospital. Had it not been for the epidemic he might readily have been called a P.U.O. (Short Term), or a bad coryza, whose nose bled when he blew it.

Case 3.—Aged 19. (Temperature chart in fig. 3.)

On December 3 he developed anorexia, generalized headaches, mild constipation and abdominal discomfort. Herpes febrilis appeared on the third day and his arms felt stiff. He was admitted to hospital on the fourth day of disease with a temperature of 99·8° F. He looked ill, the spleen was not felt, but one circular raised spot, 8 mm. in diameter, was noted on the lower third of the left forearm. Further rose spots were seen on the seventh and tenth days of disease.

From the second to fifth day after admission he was afebrile. The temperature rose on the sixth day to 99·8° F. and reached this level on each of the subsequent four days until it fell to normal.

Blood culture taken on the day of admission grew paratyphoid " B."

Inoculation State : 21.4.47.

This was a mild case and positive blood culture was obtained at a temperature of 99·8° F. He had received only one T.A.B. inoculation which had been given eight months previously.

Case 4.—Aged 21. (Temperature chart in fig. 4.)

On December 6 this man developed a frontal headache and head cold. In all other ways he felt well but reported to the M.I. Room for some medicine. On this day the epidemic was at its height and anyone complaining of symptoms possibly attributable to paratyphoid was being transferred to hospital for observation. He was therefore taken to hospital with the others, protesting loudly that there had been a mistake, and that he must have got into the wrong queue.

On admission to hospital he had no abnormal signs other than those of a coryza. His temperature was normal and remained so for the first four days. On the fifth day he

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started a fever that ran for six days though never exceeding 99·8° F. He developed no rose spots and the spleen did not become palpable.

Blood taken for culture on the day of admission, when he was afebrile, was positive.

Inoculation State: 18.11.44, 21.12.45, 26.1.46, 14.4.47.

Discussion

(1) *The Mildness of the Cases and the Value of Blood Culture in Diagnosis*

The two most interesting features of this outbreak were the mildness of the cases and the ease with which positive blood cultures were obtained at low body temperatures.

Paratyphoid " B " fever is usually regarded as being a more severe infection than paratyphoid "A" fever and more likely to be followed by complications. The duration of fever, however, in the former is usually shorter. Mild forms of both are recognized. It is well known that the severity of the disease may vary in different outbreaks. It so happened that one of us (A. B. S.) had recently seen an outbreak of 88 cases of paratyphoid "A" amongst British Troops in Cyprus. The clinical severity was greater in the paratyphoid "A" outbreak.

The main symptoms in the 40 cases described above were headache, shivering, and gastro-intestinal disturbance (most commonly abdominal pain, anorexia or constipation). If the cases had not been admitted in epidemic form, we feel that many would have been labelled influenza, sand-fly fever or P.U.O., short term. A number would not have been admitted to hospital, but treated in their units.

The average duration of fever was eight days; 56 per cent of the cases ran a fever for seven days or less. The spleen was palpable in 32 per cent of cases, and rose spots appeared in 45 per cent. In an outbreak of paratyphoid " B " fever reported by Frazer *et al.* (1937), the presence of rose spots was reported in 46 per cent of cases. In the outbreak of 88 cases of paratyphoid "A" referred to above, the incidence of spots was 36 per cent of all cases (Lucas, 1948).

The fact that positive blood cultures can be obtained in mild forms of enteric is demonstrated in Table V, and in the temperature charts shown in figs. 3 and 4. These tables and charts dispel the myth that a high temperature or severe infection are necessary to obtain a positive result. In one instance (Case 4) a positive blood culture was obtained when the patient was afebrile; in seven instances paratyphoid " B " was recovered from the blood when the temperature was below 100° F. Blood culture was positive in 54 per cent of cases.

Although this figure for percentage of positive blood cultures is not so high as is normally obtained in the Middle East, we regard the results as being satisfactory. The epidemic was an extremely mild one and the average duration of fever in most cases was both short and of a low grade.

Although outbreaks of paratyphoid fever occur from time to time in Great Britain the last major outbreak recorded was one of 123 cases in Liverpool (Frazer *et al.*, 1937). This was a severe outbreak, which affected men, women and children, and the mortality rate was 9 per cent. With the aid of selective and enrichment media Professors Wright and Glass were able to isolate

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paratyphoid " B " from the stools of 111 out of the 123 cases. No mention is made of the diagnostic use of blood culture, though, with the very high number of positive stool cultures, there was no difficulty in establishing the diagnosis in suspected cases.

In an outbreak of paratyphoid " B " fever in Worcester (Chalmers Parry, 1942) 16 out of 17 cases were proved by positive cultures of stools or urine. Blood culture was undertaken on 4 cases, of which 1 case, ultimately fatal, was positive.

We are not qualified to enter into a bacteriological discussion on blood and stool culture. We would merely like to re-emphasize the mildness of our cases, and to state that we were informed that more highly selective culture media, e.g. Selenite, were not available in this theatre at the time, though normally used. In the great majority of cases stool and urine cultures were not employed as a method of diagnosis but as a clearance test.

Manson-Bahr (1945) states that " hæmo-culture is unquestionably the most satisfactory method of diagnosis (in a case of enteric)." But " in many cases . . . negative results are obtained because blood culture is undertaken too late." In their paper on 24 cases of typhoid and paratyphoid "A" amongst immunized American troops in Okinawa Syverton *et al.* (1946) writes : " Bacteriologic examination of the blood is the most important diagnostic procedure when a case (of suspected enteric) is seen within two weeks of the onset of illness."

We would like to re-emphasize the value of blood culture and the fact that it should be undertaken early in a suspected case of enteric.

The isolation of paratyphoid bacilli in the stools of a doubtful case might merely mean that the subject was a carrier. This is a factor of considerable importance in such areas as the Middle East, where enteric fever is endemic. The temperature charts in figs. 3 and 4 also emphasize the importance of not delaying blood culture, as mentioned by Manson-Bahr. Had we waited for the fever in such cases to rise further before performing blood cultures, we should have been too late.

(2) *The Role of Prophylactic Inoculation*

The epidemic affected a unit of British soldiers whose ages ranged between 19 and 22 years. They were all Medical Category A1, and had six months to two years' service in the Middle East. The unit were not all fully protected by T.A.B. inoculation. Primary inoculation of the men had been performed in the U.K. Out of the 40, 7 had received their first inoculations in 1944, and 14 in 1945. The remaining 19 had been inoculated first in 1946 or 1947. It is understood that alcoholized T.A.B. replaced the phenolized preparation in 1945, though there was no record in their documents as to which preparation had been used in each case. In those originally inoculated with the phenolized vaccine in 1944 or early 1945 their subsequent inoculations would have been with the alcoholized vaccine.

Twenty-two cases had had two initial doses of T.A.B. and at least one " booster " dose on proceeding abroad, or within the previous year. The

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remaining 18 had had either one or two initial inoculations and then one further dose on proceeding abroad or within the previous year. In this latter group 3 men had had only one T.A.B. injection, and the remainder had had between two and four injections at intervals of several months or a year.

From the clinical account of selected cases and the temperature charts, it has been demonstrated that there was no correlation of severity and length of fever between the fully inoculated and the uninoculated.

46 per cent of the cases in the epidemic were not bacteriologically proven, but all presented the same symptoms and signs as those cases proved by blood culture. All cases came from the same unit at the same time and therefore the clinical diagnoses seem justified. For the purpose of demonstrating the relationship of severity to inoculation state, cases proved by blood culture have been employed.

It might be argued that the mildness of the epidemic was due to its occurrence in an inoculated community. But a number of the men were virtually uninoculated. We had also had previous experience of paratyphoid (and typhoid) fever in fully inoculated persons, and had noted no modification of the course of the disease. This had been the general experience of our colleagues in the Middle East, though it is not within the scope of this article to present the evidence for such conclusions.

The Narazeth outbreak was only a small one, but it demonstrated that, in an epidemic of paratyphoid fever, the fully inoculated man may suffer more severely than one who is uninoculated.

Topley and Wilson (1938) reviewed the figures for paratyphoid infection in the Great War. Among British troops in France during the Great War the case fatality rate was 1·25 per cent among 1,357 men who had been inoculated with T.A.B. vaccine. The case fatality rate was 1·34 per cent among 2,694 infected men who had not been inoculated. They concluded that there was no statistical evidence from these figures that T.A.B. inoculation had any effect upon the case-fatality-rate from paratyphoid fever.

We have been unable to obtain the figures for paratyphoid fever amongst British troops in the Second World War. Brigadier W. R. D. Hamilton, Consultant Physician to the M.E.L.F., has very kindly helped us in this matter. We have also been unable to trace a published account of paratyphoid fever in British troops during the same period. But the difficulties consequent upon reviewing the literature from an overseas station may be responsible for an error of omission. In the epidemic of 88 cases of paratyphoid "A" in Cyprus there was one death (Lucas, 1948), and in our milder outbreak of 40 cases of paratyphoid " B " there were none.

Summary

(1) An epidemic of 40 cases of paratyphoid " B " fever in a military unit is described.

(2) The epidemic was remarkable for the mildness of the symptoms and the fact that blood culture was positive at low body temperatures.

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(3) The importance of early blood culture in a suspected case of enteric is stressed. Blood culture was positive in 54 per cent of cases. In 8 instances the culture was positive when the temperature was below 100°F.

(4) Not all the men in the unit were fully protected by T.A.B. inoculations. Some of the mildest cases occurred in men who were virtually uninoculated, and the most severe case in the best inoculated of the 40. There was no direct relationship between adequacy of inoculation state and mildness of symptoms.

(5) The figures for paratyphoid fever in the Great War are quoted. They show no reduction in fatality rate for inoculated men compared with uninoculated men. No figures for the Second World War are available. This epidemic of 40 cases tends to support the view that, once the disease has been contacted, T.A.B. inoculation has no effect upon the course of paratyphoid fever.

Acknowledgments

It is with pleasure that we record our gratitude to Dr. C. G. Parsons, F.R.C.P., late Consulting Physician, M.E.L.F., for his interest and help in the study of this epidemic. To his successor, Brigadier W. R. D. Hamilton, *O.B.E.*, we wish to express our thanks for his assistance in trying to obtain the paratyphoid figures for British troops in the Second World War. To Captain D. H. Lucas and Corporal Bewick we are indebted for the bacteriology. Acknowledgments are due to the D.M.S., M.E.L.F., for permission to publish this paper.

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Addendum

After this article was submitted for publication certain further information became available. The report from the Central Pathology Laboratory, Fayid, on the phage type of the *S. paratyphi* B was received, viz. Type 3A I. Also one of us (A. B. S.) had returned to England and a more comprehensive review of the literature was undertaken.

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A detailed study of the varying clinical features of the disease was made by Miller (1917) in his Goulstonian Lectures on the Paratyphoid Fevers. The 40 cases of paratyphoid B fever that have been described in this article conform to Miller's influenzal type of paratyphoid, of which he wrote: "When one hears of small epidemics of gastric-influenza occurring in a town the suspicion should always arise concerning the nature of the infection, and it is highly desirable that paratyphoid infections should be proved or excluded."

The figures for the mortality rates from paratyphoid fever, quoted from Topley and Wilson (1938), were derived from Leishman (1923), Table XI, p. 263. In his article Leishman pointed out that the group of 2,694 subjects "uninoculated with T.A.B." were "largely inoculated with typhoid vaccine." But he also gave the case-fatality rate for a smaller group who were uninoculated with either typhoid vaccine (T.V.) or triple vaccine (T.A.B.).

THE INCIDENCE OF PARATYPHOID FEVER IN THE BRITISH ARMIES IN FRANCE FOR AUGUST, 1914–DECEMBER, 1918.

	Cases	*Deaths*	*Case-fatality %*
I. Inoculated with T.A.B.	1,357	17	1·25
II. Not inoculated with T.A.B., but a large majority inoculated with T.V. ..	2,694	35	1·34
	4,051	52	1·28
III. Uninoculated with T.V. or T.A.B. ..	325	11	3·38

The percentage of cases in Group II inoculated with T.V. was not stated. But, if it is assumed that the figures of Group III are included in Group II, then the percentage is 88. When the figures in Group III are subtracted from Group II, the case-fatality rate for those inoculated with T.V. is obtained. This is 1·01 per cent, compared with the figure of 1·25 per cent for those inoculated with T.A.B. Even if this assumption is incorrect the conclusions drawn from the original figures of Leishman are unaffected. The T.V. appeared to exert some protection against paratyphoid fever, and the fatality-rate in the completely uninoculated was between two to three times greater than in those inoculated with either T.V. or T.A.B.

An analysis of the method by which the cases of paratyphoid were diagnosed in France is of interest. The following figures were derived from Leishman's discussion on p. 229, and Table II, p. 228.

Number of cases of paratyphoid fever diagnosed by blood culture..	16 per cent
Number of cases diagnosed by isolation of *S. paratyphi* B from blood, stools or urine	43 per cent
Number of cases diagnosed by agglutination	57 per cent

While the value of blood culture in diagnosis was appreciated by Leishman, no doubts were expressed as to the validity of diagnoses made by agglutination in inoculated subjects.

Ledingham (1920, 1921), however, had considerable doubts of the accuracy

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of many of the diagnoses of typhoid or paratyphoid fever made in France by agglutination methods. He recorded his experiences in Mesopotamia, where diagnoses based solely on agglutination were not accepted because of their unreliability. Similar views were expressed by Felix (1924) on the basis of experimental work on agglutinations. In a further communication (1944) he stated his conclusions that "most of the mild 'modified' cases were wrongly diagnosed (in the Great War) owing to faulty agglutination tests."

Syverton *et al.* (1944, *vide supra*) made a detailed study of the cultural and agglutination tests in 21 cases of paratyphoid A fever. They noted that, "in several cases proved by blood culture significant titres failed to develop against the causative organism. In other cases comparable titres against heterologous antigens were sometimes observed. The reason for this was not clear, though it may have been due to the presence of common somatic antigens in the three species (*S. typhi*, *S. paratyphi* A and B), and in part to non-specific anamnestic reaction, since all subjects had been immunized previously with T.A.B."

The value of the Widal test in the uninoculated subject is not doubted, and the test may be of occasional diagnostic assistance in the inoculated. But when used in the inoculated it is important to emphasize the variable and unreliable results which may be obtained. This fact was generally recognized in the Second World War, but does not appear to have received official recognition in the Great War. The official figures for the Great War, therefore, include cases of paratyphoid diagnosed by agglutination methods only. This has produced errors of diagnosis which will have been more frequent in mild cases and in those who had been previously inoculated. As a consequence the case-fatality rate for inoculated subjects will have been affected advantageously.

A further survey of the literature confirmed our original conclusion that inoculation does not modify the course of paratyphoid fever. The figures, which we quoted, for the mortality rate from paratyphoid fever in the Great War, were incomplete. Examination of the original tables revealed that a higher mortality rate was, in fact, demonstrated in the uninoculated than the inoculated. But the diagnostic basis, on which such figures were obtained, has been shown to be open to criticism.

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COMPETITIVE HEALTH PRESERVATION IN THE ARMY

BY

Colonel F. M. RICHARDSON

The value of the competitive spirit in maintaining the efficiency of individuals and units is well known in the Army, and is recognized in the encouragement of competitions in rifle-shooting and all sporting activities. Formations, units, and subunits vie with one another in smartness. During the war salvage was encouraged by competitions in which points were allotted for the amount and value of salvage delivered to the depots; and War Savings were stepped up by publication of the amounts saved by units, and sometimes even by rewarding the best units. Field Ambulances vied with one another in efficiency and in the comfort given to their patients to an extent which often imposed a considerable strain, not only on the ingenuity of their members, but on the carrying capacity of their transport. Perhaps this suggests the need for standardization of such things as welfare equipment in order to control the snowball accumulation of things aimed at " going one better," but that is outside the scope of this article. A useful way of raising the efficiency of units' transport is to organize unexpected road checks on long moves; to award points for convoy discipline and to publish the results in unit or Brigade orders. In Field Ambulances interest and original thought in training can be stimulated by competition essays for money prizes, which may not only produce useful ideas but reveal those who have alert minds and initiative and often help in the selection of potential N.C.O.s. It is even possible that in formation exercises higher commanders may be actuated not solely by motives of pure academic research but also by the desire to get the better of one another.

There are various ways in which the soldier's competitive instinct can be applied to improving the standard of health preservation in units and formations.

Antimalarial Measures and Fly Control

In a Brigade in Palestine in which antimalaria discipline was lax I organized road patrols from my Field Ambulance, who made a note of anyone seen wearing shorts or rolled-up sleeves after dusk. The results were analysed and the culprits shown as mild or severe casualties—the worst being those whose sleeves were actually cut short. The casualty rate amongst officers and men was published in Brigade Orders.

In a camp in Sudan where fly infestation was very bad and made life intolerable despite intensification of all the usual measures and the efforts of a strong daily fly-swatting patrol almost unbelievable results were achieved in little over a month by a fly-killing competition. The unit was divided by tents and other convenient groups into teams of ten to twelve men and a running total of the number of flies killed by each team was published weekly. A standard tin of which the fly content was known was kept by the Q.M. Havildar to whom

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the teams brought their daily bag to be counted, recorded, and burned. The results soon became apparent and it was not long before the 100,000 mark was passed. The I.H.C. sepoy would do a lot for a few rupees and a good curry bât, and enthusiasm soon rose so high that the best hunting grounds had to be allotted on an official programme like the blocks in a shooting jungle. Finally the few remaining flies were being stalked by the more resolute competitors and one could see none where recently they had been swarming. This may all sound rather ridiculous but I was later discussing it with a man who had lived in Rumania, where, he said, flies had been innumerable. A similar competition on a village basis for big money prizes was organized by the Government, and the results, he assured me, were so remarkable that flies virtually disappeared from the country and the disposal of the rubbish which the flies would have eaten became quite a problem. I accept no responsibility for this statement which may have been merely a dramatic way of emphasizing the success of the scheme, but it is a stimulating thought for medical entomologists.

The Health Ladder

As I had been struck by the success of pitting the companies in Battalions and the units in Brigades against one another in the preservation of health I introduced the method in 15 (Scottish) Division towards the end of the war by a device which I called " The Health Ladder "—a term suggested by the Squash Ladder often seen in officers' messes.

A table was published, and seen by all ranks, showing units' figures for Attendance at Sick Parades, I.A.T. and Skin Sepsis, V.D., Scabies and Lice. Two separate tables were used, one for major units and one for smaller units: and during active operations the numbers of cases of exhaustion in units were also shown. The whole thing including some simple hints on health preservation based on current trends in sickness easily went on one sheet of foolscap; and on the back of copies sent to Brigade Commanders there was a graph comparing the three Brigade Groups. The first table published was for the first quarter of 1945 and it was explained that similar tables would be published monthly, so that " good " units should strive to maintain their high places, and " bad " ones should try to climb the ladder.

References to the Health Ladder and simple health hints were published regularly in the divisional newspaper. The following is a sample of the notes on preservation of health which were shown on the monthly health ladder.

The Above Table Shows Units in Order of Health The Healthiest at the Top

YOU CAN HELP YOUR UNIT TO GAIN PLACES ON THE LADDER BY KEEPING YOUR SKIN AND HANDS CLEAN, AND REPORTING TO HAVE ANTISEPTIC APPLIED TO CUTS AND SCRATCHES (I.A.T. AND SKIN SEPSIS), BY KEEPING YOUR TEETH CLEAN (GINGIVITIS AND DIGESTIVE DISORDERS) AND BY AVOIDING CONTACT WITH CIVILIANS (V.D., SCABIES, LICE AND GINGIVITIS).

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After two months the column for pediculosis was omitted and the following note made :—

"*Pediculosis : There is very little of this, and there should be none if AL 63 dusting is properly done. In future this column will be omitted and only units having cases will be shown.*"

The conditions shown on the health ladder and dealt with in the notes would of course vary with the season and the conditions prevalent at the time.

To give units something to work on in their efforts to improve their position, advice on health preservation on the usual lines was circulated. This dealt with the prevention of V.D., scabies, lice, respiratory infections, with fly control and so on ; but the main attack was on septic conditions, which are always with us and seem to be too often taken for granted although a lot can be done in prevention.

As an R.M.O. I used to think it unreasonable to punish men who took no precautions against V.D. and not similarly to punish men who took no precautions against sepsis. I kept a book in which were recorded the names of men who reported for acriflavine to be put on cuts and scratches, and a man who became septic was liable, if his name was not in the book, and if the M.O. thought that he had neglected himself, to be punished. Disciplinary action was taken against any man whose underclothes or body were neglected. and all were encouraged to keep a separate outfit to sleep in or, if this were impossible and sheets were in use, to sleep naked. Many Regimental Officers nowadays do not seem to know in what clothes their men sleep, nor do they always take enough interest in the state of their underclothes ; and they are satisfied if a man possesses a toothbrush whether he uses it or not. This is as unreasonable as to regard the possession of a pullthrough as an excuse for a dirty rifle.

Sick wastage will be reduced when as much attention is paid by all officers to dirty underclothes, dirty hands with grime under the nails ready to inoculate germs by scratching, and dirty teeth, as is normally paid to dirty equipment.

The results of our competition soon became apparent and graphs for the various conditions seemed to confirm our impression that the attention which was focused upon the prevention of sickness was having remarkable results. Even if we had been able to get accurate rates per 1,000 to compare the figures before the scheme began with those after it, figures can be so juggled and conditions vary so greatly that accurate statistical comparisons would be difficult. Our strength remained much the same and the rates of sickness greatly improved, and the results described in general terms can fairly be said to have been excellent.

In 1944 the Division had had hardly any V.D. or scabies and no gingivitis at all, but despite the very great increase in those three conditions in 1945 especially after the end of hostilities, despite the generally recognized tendency of the soldier to report sick more readily when the fighting was over, and despite the fact that during most of 1945 all accidents were included amongst " Sick " (whereas in 1944 many of these were shown as " Battle Accidents " amongst the Battle Casualties), we had only a total of 28,204 men reporting sick in the

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whole of 1945 compared with 18,217 in half of 1944. Excluding V.D., scabies and gingivitis, which all formations were finding it difficult to control, our figures were 25,186 for all 1945 and 18,022 for half 1944.

Injuries at games increased after the end of hostilities and if we had extracted all accidents from the sick rates for both years the comparison might have looked even more encouraging. Of course with the end of hostilities morale improved and men lived more comfortably, and if they had more time to report sick they also had more time to devote to personal hygiene and health preservation, and many of them would have done so without our propaganda. Some will say—the worst units sometimes did say—that M.O.s will be persuaded by C.O.s to " cook " their figures. We looked out for this and did not believe that it occurred, but even if M.O.s did treat more minor cases out of working hours and without the absence from duty involved even by " Attend A " that meant a saving of man-power which was the aim of our scheme. If M.O.s could " cook " figures for attendance at sick parades they could hardly " cook " those for admissions to medical units, and despite the tendency to admit more of the slighter cases after fighting ceased we had only 4,293 for all 1945 compared with 5,528 for half 1944, a reduction of more than 50 per cent and fairly good evidence of a healthy Division.

No claim is made to have proved the value of the method by accurate statistics but commanders and medical officers agreed that it seemed to work wonders by focusing universal attention and keen interest on health preservation. If it caused occasional ill-feeling this was only apparent in units with poor figures, and it is not uncommon for the losers to criticize the rules and method of running of any competition. Indignant C.O.s who swore that the others did not play fair could often be shown at a visit where their own methods could be improved. Never a month passed without many enquiries on the subject from Brigade Commanders and unit C.O.s, all of whom were keenly watching their rates of sickness; and R.M.O.s reported that not only officers but N.C.O.s and men watched their position on the Health Ladder and were keen to improve it.

A year's experience of the method in a Division, added to previous experience in Brigades and Battalions, convinced me that interest in Health Preservation can be greatly stimulated by competition. In present conditions the methods described may not be easily used in formations but should be of value within major units.

Prevention of War Neuroses

It may be thought that it was a little unkind to show in a separate table on my health ladder all units which had cases of exhaustion; but two months before such cases were given publicity the whole Division had been advised how to reduce the incidence of such conditions, and the competitive spirit had been invoked by urging units to regard it as a disgrace to have many such cases and to strive to make our Division the best in the Army. Certainly such an attitude may be hard on some cases but the condition is largely preventable and to take the opposite view is defeatist and may be disastrous. Thus whilst

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investigating the problem in another Division I had been told by one C.O. that he had been told by a senior medical officer that he need not reproach himself for having 150 cases in his unit since nothing could be done to prevent it; and in another unit the men had heard that a Corporal evacuated for exhaustion was being fêted in his home town as a wounded hero.

Much has been written about exhaustion and I may have little new to say, but my experience of these conditions from 1941 to 1945 convinced me that not nearly enough was done in prevention; so I hope that as a mere dabbler in "drawing room psychiatry," as a real psychiatrist would probably describe one who follows in a rather vague way the teachings of Alfred Adler, I may be forgiven for describing my methods and their results.

During the severe fighting in Eritrea and in minor operations in the Western Desert in 1941 I did not see much of the kind of states of which we saw so much in Normandy. The Indian soldier, fine fighter though he was, was not immune from conscious or unconscious desires to escape from the battle, but he tended when things got too much for him to escape from them by more direct means than by the flight into neurosis which the British soldier sometimes adopted. One saw self-inflicted wounds and actual flight occasionally, and both amongst Indian and British soldiers in those days I saw more of hysterical conditions than of the various other states included in the unsatisfactory term exhaustion. I was struck by the ease with which by simple persuasion and explanation of the cause of the condition even an inexpert practitioner like myself could cure these patients if they were caught on the battlefield itself. It seemed that if one caught them whilst the emotions which caused the condition were still operative they were like a jelly which had not set, and if one could pour it into a mould of one's own choosing they recovered, whilst if allowed to pass the C.C.P. they set firmly into the hysterical or neurotic state and were lost to the Division. We had a rest station at the foot of Mount Dologorodoc, near Keren, where such cases could spend twelve to twenty-four hours before returning, without any loss of face, to their units. Attempts to cure them on the spot amongst those who had seen the condition develop were not successful, presumably because this would have demonstrated that the condition was not to the lay mind a "genuine" one, and loss of face would thus have been involved so that cure was consciously or unconsciously resisted. For example a soldier seen in the wide trench surrounding the summit of Mount Dologorodoc, which was part of the fort, had a hysterical paralysis of both legs after a mortar had buried his friend at his side. He had to be removed as a stretcher case but once out of sight of his friends and in the C.C.P. some 200 yards away he was easily convinced of the true nature of the condition and walked down the hill to the rest station. In another theatre an officer suddenly called on to take command of his battalion woke next morning with a hysterical drop wrist. It was his left wrist so that he was still able to carry on and one felt justified in telling him that his surrender to his feelings of inadequacy was only a partial one. When it had been explained to him that the condition was a self-protective mechanism which had developed when he was confronted by a situation which he unconsciously felt unable to face he recovered, though not so quickly as

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had been the case in some private soldiers with similar conditions, perhaps because his disability had naturally been more widely known about. After his recovery he asked whether the incident denoted some inherent weakness in his make-up and if therefore under future strain some similar breakdown might be expected. He was assured that the insight which he had gained on this occasion would protect him from further trouble, and whatever the most scientific prognosis should have been the answer given him was I feel sure the best one and his subsequent career amply proved this.

These very ordinary cases are mentioned only to stress that the results which followed simple explanations of the nature of their trouble to cases caught early enough clearly indicated that widespread teaching on these lines could do much to prevent these conditions. I discussed this in 1941 in Palestine with a psychiatrist, and together we planned a campaign in the Brigade with which I was then serving. At a guest night to which the Brigade Commander and staff, and the Commanding Officers of the Regiments and their seconds in command and medical officers were invited, after a preliminary alcoholic softening process the psychiatrist delivered a surprise attack in the shape of a ten-minute talk. The interest aroused by this finally led to a whole morning devoted to three short addresses by the psychiatrist on Fear, the genesis of War Neuroses, and their prevention, which provoked many questions and a lively discussion. This meeting was attended by all officers and N.C.O.s in the Brigade Group who then disseminated the teaching in their units. This Brigade, as the armoured brigade in the 2nd New Zealand Division, subsequently played a most important role in the Battle of Alamein and, despite heavy casualties in tanks in very severe fighting, had virtually no cases of neurosis. We were dealing here with regular soldiers and with the flower of the English yeomanry but the results were sufficiently promising to encourage me to try similar methods in a Brigade of 49th Division destined to take part, less than two months after I joined them, in the Invasion of Normandy as a follow-up Division. Time was short but, although I gathered that morale in the Division was high and that such cases were not expected to become a serious problem, I was given a free hand in the Brigade and everyone in it quickly became interested. A leaflet on the regimental officer's part in the prevention of neurosis prepared for me by the Corps Psychiatrist, Major J. Wishart (*see* Appendix A), was circulated to units with a letter from myself in which amongst other things I suggested that to have many cases of this preventable condition should, like gas cases, be regarded as a disgrace. I also gave some short talks on the subject and C.O.s took it up with enthusiasm. Fear and individuals' reactions to it were treated as proper subjects for discussion with all ranks, being sometimes treated as an " ABCA " subject, and so were brought out into the open and kept there throughout the fighting.

It is common knowledge that the incidence of exhaustion became quite a problem in Normandy and at one time my Field Ambulance whilst out of the line ran an exhaustion centre where we were able to study the cases. The low incidence of cases in the units which had been subjected to the propaganda mentioned above emphasized the value of such methods in prevention. In

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August 1944 as chairman of a board of officers I was given the task of studying the problem in the whole Division and visited every battalion to discuss it with C.O.s and officers, R.M.O.s, Chaplains, N.C.O.s and men. Our report is an interesting one, although hastily prepared, because it combines the medical with the regimental officers' views on the subject, but it is too long to be included in this paper which is not intended to be a detailed contribution to the literature on exhaustion.

Finally I had the opportunity of trying my methods in 15 (Scottish) Division which I joined as A.D.M.S. twelve days before the Reichswald battle (Operation "Veritable"). After that battle I circulated to all units Major Wishart's notes with a letter embodying some of my own ideas (*see* Appendix B), in which it will be seen that the idea of competition was introduced in somewhat flamboyant language for which my apology is that it seemed to produce results. C.O.s also received a copy of the report referred to above, on which in one Brigade they were required to submit their views to the Brigade Commander. That particular Brigade led the assault across the Rhine, took part in several stiff encounters in the fighting advance to the Elbe, and was an assault brigade at the Elbe crossing, and in all these engagements had only one mild case of exhaustion.

Statistical comparisons in this particular condition are clearly difficult, and the best guide is a study of the ratio of cases of exhaustion to battle casualties; and even this may be misleading when comparing one unit with another since certain units such as the Reconnaissance Regiment or Divisional Regiment R.A.C. may be subjected to the maximum mental strain without a liability to heavy casualties and others such as Royal Engineer units may be exposed to casualty risks without the elation of actual combat.

Our figures were as follows:

RATIO OF EXHAUSTION TO CASUALTIES

Operation	*Exhaustion*	*Wounded*	*Exhaustion*	*Killed, wounded and missing*
Veritable	1	7	1	9·6
Torchlight	1	19	1	24·9
Advance to the Elbe	1	24	1	35·0
Enterprise	1	13·3	1	16·8

These figures show the improvement after the inauguration of the campaign in Prevention, which was begun AFTER Operation "Veritable"; and they would have been still better but for an unfortunate incident during the Elbe Crossing (Operation "Enterprise"). During that battle a large number of cases from one Field Company R.E. were sent back by an officer who was himself somewhat shaken and at least twelve of them were believed to be not true cases. This fact was reported to me not only by the O.C., A.D.S., but by the D.D.M.S., who was in the A.D.S. when all these cases came in and who gave me the name of the officer and directed me to enquire into the matter. We found that many of the cases had not wanted to be evacuated at all, but some of them had suffered severe concussive experiences. The officer had acted

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in good faith but he had been on leave when my letter and the leaflet on exhaustion were circulated, and he had omitted to read them in the officers' file of his unit. Careful analysis of those cases led to the conclusion that 9 were definitely NOT cases of exhaustion and if those 9 cases are excluded our ratios for this last battle of the war would have been 1 : 25·3 and 1 : 32, i.e. the steady improvement was maintained.

In considering these figures as proof of the value of prevention many more or less imponderable factors have to be considered. We were not enduring the stalemate conditions of the Normandy bridgehead but were advancing in the ever surer belief that victory was in sight, and although the opposed night crossing of the Rhine with its noise and confusion may well have daunted the fainter hearts there was the feeling that it might be the last big battle; later there was the inspiring sight of the mighty airborne force passing overhead: the weather was fine, and though there were heavy counter-attacks and periods when troops were pinned down by fire these did not last for days and the operation was short and sharp. The advance to the Elbe was rapid and exciting but included some severe fighting against fanatical battle groups and a stiff siege at Velzen; the Elbe, though a smaller river, was in many ways a harder nut to crack than the Rhine, there was much less air support, and shelling and bombing of our crossing was much heavier. Before that battle there had been much talk of peace overtures and the desire to keep a whole skin over the last fence might well have led to an increase in cases of exhaustion; as might certain other factors which emerged from a careful analysis of 58 of the 68 cases which occurred after our preventive methods were introduced—the other 10 cases were not treated in our own F.D.S. 45 per cent of all our cases were returned to units, the figure in the case of our own F.D.S. being 47·5 per cent: and the Corps psychiatrist said that a case which reached him from our Division was always a genuine one. Commanding Officers and R.M.O.s protested against our policy of returning so many cases, and indeed evacuation of more cases would have pleased them and enabled us to show better figures, for 48 per cent of our cases were recurrences. Units had been warned of the tendency of these cases to relapse and asked not to employ them forward of "A" Echelon, but this was often impossible. It is possible that we did return too many of these men to their units, but at that time the conservation of man-power was vital and reports from units indicated that many of them did do useful work. 48 per cent of our cases were aged from 18 to 21 and 10·3 per cent from 37 to 40. The older men, mostly sappers, had endured prolonged physical and mental strain, and in this group and in the men from 21 to 30 the progressive strain of the war and the fact that many had been wounded once or more in previous operations and had not fully regained their self-confidence were causative factors.

The younger men were a more serious problem for we were at that time getting reinforcements of a very poor quality indeed, some of whom were found to be suffering from exhaustion when they joined their units and some had suffered from the condition in other formations. Most of them, however, had had no battle experience before; and many had less than six months'

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total service, 40 per cent having had between one week and three months' service with their units. The tempo of the operations did not allow of training these men nor of introducing them gradually to their job and to the corporate family spirit of the Battalion which is so important in preserving the high group morale which is essential to the reduction of cases of exhaustion. They had had no time to absorb the unit *esprit de corps* or to form sound friendships which have a steadying influence and help men to trust themselves and their comrades, and so to have their personal instincts of self-preservation balanced by herd instincts directed to a common resolution to overcome danger. From the more limited point of view of this enquiry many of them had not been indoctrinated with the principles upon which we based our attempts to prevent breakdowns.

Our analysis of these cases further convinced me that the adoption of the term " exhaustion," more properly described as an administrative label than as a diagnosis, was most unfortunate. It provided the busy medical officer with a ready diagnosis for cases which a more careful clinical appraisement might have placed in some category not associated with the slight stigma which a diagnosis of exhaustion involved. Thus 29 per cent had suffered some effects of blast, some even had ruptured ear drums, and these some medical officers felt should have been called concussion or post-concussional syndrome ; and careful reconsideration of other cases suggested that they were not true cases of exhaustion. In one series of cases from units which had been pinned down by fire and had not been supplied with water for considerable periods in hot weather, quite severe dehydration was a feature of the cases. It was not only to the doctor that this " label " gave an easy way of dealing with a difficult case, for regimental officers and N.C.O.s often sent a man to the R.A.P. with this diagnosis when he was more properly a problem for themselves, perhaps even a disciplinary problem. Men frequently wandered back to the R.A.P. and quite jauntily announced that they were suffering from exhaustion and the average case clearly felt that no stigma was attached to his failure to stand up to conditions which he had left his comrades to face. In the 1914–1918 War the condition was called shell shock and was treated as a battle casualty and it was widely recognized in the Second World War that this had been an expensive mistake which must not be repeated ; yet that mistake was perpetuated in a lesser degree by the use of the term exhaustion with its suggestion of the tired soldier who had fought hard until he could fight no more. Many cases were indeed entitled to that description but many were not and a few were even cases of pure funk. The term used in Eritrea was " fear neurosis " which seems to be a reasonably accurate description, and was at least a diagnosis with which the average soldier would not want to label himself.

To sum up the results of our efforts to reduce this condition it may be said that, however misleading figures may be, the value of our methods, as was the case with the health ladder, lay in keeping attention focused on the many aspects of man management which can reduce these cases.

The experience of one Brigade has already been mentioned and there was every evidence that the problem was constantly watched throughout the

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Division. Very few cases indeed ever drifted back on their own, and nearly all came to the R.A.P. with a note from an officer which helped the R.M.O. to make a diagnosis and to decide upon disposal. Many were treated at the R.A.P. by rest and sedation before evacuation.

Notes were sent periodically to medical officers and commanding officers giving the incidence of cases in various engagements and describing apparent causative factors, such as the dehydration already mentioned. Tables showing the ratio of exhaustion to casualties were circulated to the units affected thus further keeping alive the spirit of competition. That interest in all aspects of prevention was stimulated was proved by the many questions and requests for advice which were received.

Summary

Most of the conditions which were included in the administrative label "exhaustion" are caused by the more or less unconscious adoption of some sort of hysterical or neurotic symptom as a self-protective mechanism when the man is confronted by a situation which he feels it is impossible to face.

Broadly speaking they are cured by laying bare and explaining their origin and by giving the sufferers insight into the true nature of their condition and the earlier this can be done the better the prognosis; and my experience in various formations convinced me that they can often be prevented by giving as many men as possible that insight, before they are exposed to the precipitating conditions. As indicated in Appendix B much of this must be done by deliberate teaching by medical and regimental officers in which fear and the soldier's duty to face and to overcome it are discussed; and *esprit de corps*, team spirit, determination and confidence in oneself, one's weapons, one's comrades and commanders, and in the supporting arms are fostered. When all ranks understand the problem and how it can be overcome then it is proper to introduce the competitive spirit and to aim at being the unit, Brigade, and Division with the fewest cases; and to teach that to have many cases is a disgrace, the blame for which must be based mainly upon the officers as the custodians of unit morale.

Prevention of Neuroses Between Wars

Having said all that I have to say about the competitive pursuit of health it would probably be wiser to stop, but, at the risk of being thought the kind of person who rushes in where better-balanced individuals fear to tread, I want to suggest that some of the methods by which I have found that war neuroses can be prevented could be extended to an attempt to improve the mental health and moral standards of the Army in peacetime. This would simplify the task of preventing war neuroses should war come again, and since morale is one of the most important factors in war anything aimed at improving it is as important as weapon training.

If the fear which leads to a breakdown is less the fear of the enemy or of being wounded than a fear of being afraid and of being thought to be a weakling and a coward, a fear that one's moral and physical fibre is less able to stand

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up to the strain than is that of one's comrades, then clearly anything which gives rise to feelings of inferiority or inadequacy—the popular "inferiority complex"—must be an important predisposing factor. In studying these cases I found that most of them had such feelings of inferiority, usually derived from a false evaluation of their own personalities. No one who has attempted to deal with such cases will be surprised that many of them suffered from what is sometimes called "masturbation guilt"—from morbid fears about the fancied evil results of that practice whether it was being practised at the time or had been abandoned since earlier youth. So common was this finding that the first draft of my letter (Appendix B) included a brief paragraph about it, which the Divisional Commander, very wisely as I now believe, preferred to have deleted.

The inclusion of teaching on so thorny a problem for general consumption as part of an attempt to reduce exhaustion in the last lap of the War might have been unwise, but it is a different matter in peacetime when we are responsible for the moral welfare of the National Service Soldier, often in circumstances in which he is exposed to difficulties, doubts and temptations.

Alfred Adler taught that the happy well-integrated man must be properly adjusted to the claims of Society, of Occupation, and of Sex.

Good man management aims at adjusting the soldier to the first two of these, but the attitude of the Army to the third is not always so sound, and it is probably the most important of the three and the one in which maladjustment is most common.

Many lectures on V.D. and the average officer's and man's way of talking about this subject tend to imply that occasional or even regular sexual intercourse is the normal practice of the healthy virile young soldier, and without doubt the apostles of this creed are more confidently vocal in the barrack room, as indeed they are in most male society, than are those who may hold that continence and pre-marital virginity is a Christian virtue and a desirable thing in itself. Thus many young men joining the Army quite ignorant of the subject are led by such talk either to promiscuity or to a belief that they are, as they usually put it, "undersexed," or even to an unfounded fear that they may be homosexual, and they may withdraw into a life of masturbation with consequent feelings of guilt and inferiority. That such reactions do occur is no mere surmise and most doctors in the Army must have encountered cases illustrating these and other results of the lack of clear teaching on this subject. The Army draws its men from every stratum of society and no uniform standard of sexual behaviour is to be expected, but it is only fair to those adolescents who are in a state of uncertainty that the other side of the picture should be presented, and that the common omission of parents and teachers to give instruction on the subject should be remedied. Certainly most lecturers on V.D. do advise continence, and this point is stressed in the pamphlet "The Medical Aspect of the Moral Welfare of the Soldier" in use in the Middle East Land Forces, but I think that it is commonly suggested to the audience more as the best way to avoid V.D. than as an aim in itself and a factor in an eventual happy marriage which shall be an ideal relationship into which both partners enter upon an

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equal footing without secrets to conceal. The idea of continence can hardly be presented without some sound teaching on sex in general aimed at dispelling the many false beliefs which surround the subject such as the imagined effects of continence upon potency and virility and the even more widespread fears of the fancied evil effects of masturbation. This is a subject which bristles with difficulties, dangers and prejudices. Any doctor can guide individual patients in these matters but mass teaching is very difficult if some are not to misunderstand it. I have attempted to tackle the problem since my very first lecture on venereal disease as a subaltern at which a vast audience was present, surprisingly enough including a general. I shall never forget my feelings of impending dissolution, or at the least impending resignation, when I huskily announced that I was finished, nor my relief when, as the audience stood up to go, from the third row of the stalls a popular and bull-voiced officer bawled " Well doctor you've certainly taken a load off my mind" (sensation! followed by roars of laughter).

I know how I tackle the problem, and have had evidence that men have been helped by it ; I have submitted my views in writing to my betters ; and have discussed them with many colleagues—some have agreed with me and some have not.

No two doctors will use the same approach, and this is not the place in which to stuff my views down people's throats ; but to be sufficiently widespread this important teaching cannot be left entirely to doctors. What is wanted is a pamphlet produced by psychiatrists assisted by chaplains from which sex, and perhaps other subjects of importance in moral rearmament, can be taught as a current affairs subject.

The medical officer's help will always be valuable and one of the aims of the teaching will be to remove the reticence usually felt about discussing sexual problems, and to make men realize that it is as easy, and just as important, to consult the doctor about sex as about sore feet. Such an approach to the problem should not merely help to prevent venereal disease, but should lower the incidence of psychosomatic illness, and so lead to a healthier Army and one which in wartime would have little war neurosis. It has become quite a platitude to say that moral standards always decline during and after a war and a campaign which had as its aim a raising of moral standards and an improvement in our young soldiers' psychological adjustment to life might even have more far-reaching results in this post-war world. The opinion of a winner of the Nobel Peace Prize must always carry weight and in a review of Sinclair Lewis' book " Cass Timberlane " the following words are quoted as stating the book's thesis.

" If the world of the Twentieth Century . . . cannot succeed in this one thing, married love, then it has committed suicide, all but the last moan, and whether Germany and France can live as neighbours is insignificant compared with whether Johann and Marie can live as lovers."

It has been said that a nation's sexual and its social activities are in inverse ratio, and, although one must not forget the bibikhanas of the ripe old John Company days and the villages peopled by the Anglo-Indian descendants of

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some of our greatest soldiers of those times, it is not improbable that much of our Empire was built by men who could keep their sexual emotions in control, and who perhaps by the process of sublimation derived therefrom some of the driving force which enabled them to accomplish what they did.

Field-Marshal Lord Montgomery has said "Anything which weakens the national character weakens the Army" and "The Army must be woven into the social fabric of the nation."

The Army in the coming years will be handling a very big proportion of the nation's young men at an age when they need education, and widespread teaching on the various subjects included in the term mental hygiene will help us to return good sound material to be woven into the social fabric of the nation.

I have to thank Brigadier T. H. Twigg, D.D.M.S. Malta Command, for permission to send this article for publication.

APPENDIX A

NOTES ON THE PREVENTION OF WAR NEUROSES

BY

Major J. WISHART

30 *Corps Psychiatrist—April* 1944

MODERN war is primarily a contest of morale. Victory lies in demoralization of the enemy. Morale is based on a sense of worth and power directed towards a goal. War neurosis is, in the last resort, a failure of morale—in the individual or in the group. Promotion of high morale is thus the best preventive of neurotic breakdown.

Individual morale, assuming average constitutional stamina to begin with, is supported by :

(1) *Knowledge of the Aim.*—Men grasp concrete and limited aims better than abstractions. Whenever possible, tell them what is to be attained and what their part is to be. Rumours engender doubts and uncertainty. Foreknowledge dispels rumour.

(2) *Positive Health.*—Not just absence of disease. Fit men fight better. Basically this depends on food, sleep, and activity of mind and body. See that food is ample, and, whenever possible, hot and appetizing. Practise acquiring the ability to sleep at unaccustomed time. Allow short breaks for recuperation, e.g. brewing up. Physical exercise aids general fitness, but exhaustion lowers resistance.

(3) *Contentment of Mind.*—The soldier fights for his home. His photographs are precious. If his home is disrupted, he feels insecure. If there is sickness, or financial distress, he becomes anxious and may be resentful, his morale is undermined, and he is predisposed to breakdown. Spare no pains to help him through the Welfare organizations. Herein lies the paramount importance of a swift and regular mail service.

(4) *Competence at His Job.*—See that each man can do his job well. If he

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cannot, find out why. Is it lack of intelligence, lack of training, worry, physical incapacity, or just being a square peg ? Has he confidence in his weapons and in his ability to use them ? Give praise for work well done—this increases the feeling of worth.

Group morale partakes of all these, but has additional features :

(1) *Unit Spirit.*—Remember the importance of tradition—i.e., past achievements. Play up to it.

(2) *Team Spirit and Training.*—Training together and working together, the soldier becomes imperceptibly to rely on his mates and they on him. This engenders a feeling of security—each knows what his job is and how he fits into the team—" family " ties are made and strengthened. Do not break up trained teams without good reason. Encourage friendly rivalry, yet retain the " family " basis and widen the ties to include relationship with other units in the formation.

(3) *Leadership.*—This is critical. An officer must be able to make a decision, stick to it, and lead. His responsibility is that of the father in the family constellation. If he breaks, men will break.

(4) *Discipline.*—True discipline is the maintenance of a calm orderliness, of justice and fairness, and helps to strengthen a man's belief in himself and trust in his superiors.

Remember to watch for incipient breakdown—neurosis is infectious and panic spreads. The early signs of restlessness, sleeplessness, loss of appetite, irritability, rise in consumption of tobacco or alcohol, change of temperament with unaccustomed elation or depression, deteriorating efficiency, " jumpiness." Send the man to the R.M.O. with a note—rest and sedation taken in time at a forward psychiatric treatment centre can avert breakdown.

See that the period of tension before action is relieved by activity—even trivial activity provides an outlet for pent-up emotion. If a man appears to be weakening, put him next to a steady, experienced soldier who will act as a " battle friend " and help him through. Let a man discuss his fears—bottling up emotions increases tension—point out that fear is the normal reaction to danger but that it is overcome by determination, by sticking together and by experience.

Anticipation is generally worse than realization. Stress that some weapons are far more terrifying than lethal—such as screaming bombs.

Make enquiries about the progress of casualties—and spread the news that they are in good hands and doing well. During rest periods, see that wholesome entertainment is provided to distract attention from the unpleasantness of war.

APPENDIX B

EXHAUSTION

CONFIDENTIAL

DURING Operation " Veritable " 15 (S) Div. had 155 cases of " Exhaustion." From a study of the cases and the factors causing them, I do not think that this is too bad ; but I am convinced that we can reduce this drain on our man-power.

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I have proved in two brigades that the incidence of exhaustion can be greatly reduced by sound propaganda amongst all ranks about its main causes.

The Regimental Medical Officer is of course an essential factor in such a campaign ; and so is the Chaplain for, although it is outside my province, I know that many men are saved from a breakdown by sound religious beliefs. Helpful though the doctor and the padre are to men who are beginning to show signs of failure, the regimental officers and N.C.O.s for whom these notes are intended, have probably a still greater influence in prevention.

The term exhaustion is in some ways a bad one since it has been used for many cases of pure physical fatigue ; for some which might have been due to mild concussion or to effects of blast ; for a wide range of neurotic and hysterical conditions ; and also for many cases of lack of " guts " and of fear in which it has been a toss up between the R.A.P. and the guardroom. It is of utmost importance that such cases should not be allowed to drift back to the R.A.P. without an officer's permission.

Good advice on PREVENTION is given in the attached leaflet by the 30 Corps Psychiatrist and I would like to add the following remarks :

Man Management.—Good man management by Officers and N.C.O.s is the most important single factor in prevention. When an Indian soldier makes a request of his Officer he often says " Sir, you are my father and my mother." A good Officer must know when to use the punishing right arm of the father, and when the protecting arm of the mother.

The importance of occasional enforced REST cannot be overstressed. If it is possible to have a rest centre near Coy. or Battn. H.Q. (especially when in a defensive rôle) to which men are sent periodically or when showing signs of strain, many breakdowns may be prevented.

Men in the early stages of a breakdown who report to the R.M.O. can often be sent to such a centre or to "A" Echelon for twenty-four hours rest, and so avoid evacuation by medical channels and the stigma of a diagnosis of exhaustion.

Square Pegs in Round Holes.—When reinforcements arrive it is usually impossible to employ them all in the job which they prefer and for which they are trained; but the adjustment of " misfits " is very important, since they are apt to mistrust themselves, and, still worse, to feel that their comrades mistrust them.

Confidence in one's personal weapons, in our armour and army, belief that one is the better man, etc., all need cultivating.

The skilful grafting of reinforcements into a Battalion with its spirit and traditions is most important ; and if they can be rather gradually introduced to battle, so much the better.

Fear.—Perhaps most important of all is a sane attitude to fear. Men are often not so much afraid of danger as they are of showing fear, and adopt an easy way out to avoid open disgrace. They fail because they believe themselves to be the only cowards amongst a band of heroes. It must be TAUGHT that fear is the NORMAL REACTION to danger and is felt by ALL normal men. A brave man is NOT one who feels no fear, but one who, though afraid, goes on with his

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job. Fear, like trench foot and lice, is a normal battle risk to be faced and overcome.

In a Battalion in Normandy which had hardly any "exhaustion," fear was openly talked of and had been freely discussed at Platoon " ABCA " talks based on the sort of points mentioned here.

General Attitude.—However hard it may be on some cases, we must teach that it is a disgrace for a unit to have many cases of exhaustion.

We should aim at having fewer cases than any other Division in the Army, and at being able, as I believe we can, to add this to the collection of feathers already in our bonnets.

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WHAT EVERY MEDICAL OFFICER SHOULD KNOW ABOUT THE ATOMIC BOMB[1]

The Second instalment of a Series of articles reprinted from The Medical Bulletin of the United States Army by permission of the Editor

IV. Evaluation of the Five Atomic Explosions

Employment of the bomb. The atomic bomb is primarily a strategic weapon, and the choice of target and method of employment require the evaluation of a number of factors. Thus far, five atomic bombs have been detonated, three of them under test conditions. The one factor that makes an atomic bomb detonation different from the detonation of any other type of weapon is the nuclear radiation produced. All high-explosive weapons produce high temperature and high blast pressure, and the only difference in these respects between atomic and conventional weapons is the increased magnitude of the blast and thermal effect produced by the atomic bomb. However, no other weapon devised to date is capable of releasing nuclear radiation.

The first bomb was set off under experimental conditions from a tower near Alamogordo, New Mexico, on 16 July 1945. The second bomb was dropped, 6 August 1945, on the city of Hiroshima from a B–29 bomber. Over 4 square miles of the city were instantly and completely devastated; 66,000 people were dead or missing and 69,000 were injured. On 9 August another B–29 dropped an atomic bomb on Nagasaki, totally destroying 1.5 square miles of the city. The number of persons dead and missing in Nagasaki was 39,000, and 25,000 more were injured. The fourth atomic bomb was dropped by a B–29 on target vessels assembled in Bikini lagoon on 1 July 1946, and the fifth was detonated underwater on 25 July 1946. Test animals placed in various locations on the target vessels yielded important data on the bomb effects. This work was under the supervision of the Naval Medical Research Center.

Action of the bomb. When a mass of fissionable material equal to or greater than a critical size is assembled, a violent detonation will occur. The subcritical masses of fissionable material must be brought together rapidly in such a manner that a chain reaction and detonation will occur. The bombardment of each fissionable nucleus by neutrons results in the formation of two fragments known as fission products. All nuclei do not split into the two types of fragment; therefore, many radioactive substances (fission products) are liberated. The sum of the masses of these fission products will not equal the original mass of the split nuclei. The difference between the fission products formed and the original mass represents the mass of the nuclei that has been converted into energy in the form of blast, heat, light, x-rays, gamma rays, and released nuclear particles.

[1]The fourth, fifth, sixth, seventh and eighth of a series prepared by the Special Projects Division, Office of The Surgeon General.

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The detonation of the atomic bomb generates a crushing wave of high pressure. The bomb also liberates an enormous quantity of electromagnetic radiations and neutrons. The electromagnetic radiations include infrared, visible light, ultraviolet, x-ray, and gamma radiation. Thereafter, the fission products formed emit gamma rays and beta particles. The unfissioned bomb residue emits alpha particles. Substances bombarded by neutrons released at detonation, which become radioactive by induced radioactivity, may also emit nuclear particles and gamma rays. A large fraction of the gamma rays is emitted in the first flash of the atomic explosion. Neutrons also accompany this reaction. The range of neutrons is negligible at 1,000 yd. because of their absorption in the air. In an underwater burst, greater absorption occurs, resulting in induced radioactivity of the sea water. Of the constituents of sea water, only sodium is of any significance, and even this element is hazardous for only a limited period because of its short half-life (14.8 hours).

At detonation, practically all of the lethal gamma radiation is released, and the remaining small fraction of the total dose is given off by the resultant fission products that rise rapidly in the bomb cloud. The column of radiating fission products and combustion material rapidly rises into the air and begins to mushroom out when the temperature of the column is equal to the temperature of the surrounding atmosphere. The climatic and meteorologic conditions will govern the diffusion, dispersion, and radiation activity of the cloud. The fissioned and unfissioned material in an airburst will be distributed in the atmosphere; while in a subsurface waterburst, the adjacent water, ships, and land facilities in proximity to the detonation will be seriously contaminated. Fission products in the cloud may be dispersed as fine particles of varying size, and, depending on many factors, a shower of the radioactive material will fall on nearby areas. The fission products, therefore, present a continuing health hazard for a considerable time as an aftermath of the explosion. In general, regardless of the technique of bomb detonation, radioactive materials emitting alpha and beta particles and gamma rays will be encountered. The radioactivity of these substances will range from a few seconds to years. Violent changes in temperature, strong magnetic or electric fields, and drastic chemical interactions have no effect on the rate of transformation or emission characteristics of the radioactive substance. If an element is radioactive, it will decay normally according to its inherent half-life.

In the underwater detonation of the bomb, thousands of tons of water rise in a column, a few thousand feet in the air, followed immediately by a rapidly moving mass of water, constituting the base surge. The turbulent waters contain a high percentage of the fission products and unfissioned residue. Immediately at detonation and for a short period thereafter an enormous amount of radiation is emitted. The falling column of water and mist, depending on wind conditions and depth of detonation, contains a high percentage of the fission products and unfissioned residue that can contaminate an area of several square miles for a considerable period.

The emission of infrared, visible, and ultraviolet light occurs a few milliseconds after the explosion. The ball of fire in the airburst grows rapidly in

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size. As it grows, its temperature and brightness decrease. Several milliseconds after the initiation of the explosion, the brightness of the ball of fire is several times the brightness of the sun. Most of the infrared and ultraviolet radiation is given off after the point of maximum intensity. The ball of fire rapidly expands from the size of the bomb to a radius of several hundred feet at one second after the explosion. Thus, the infrared and ultraviolet radiation comes in two bursts—an extremely intense one lasting a fraction of a millisecond and a less intense one of much longer duration lasting several seconds.

The heat from the flash in an airburst occurs in a short time, and, since there is no time for any cooling to take place, the temperature of a person's skin can be raised 50° C. by the flash of infrared and ultraviolet rays in the first millisecond at a distance of over 4,000 yards. People may be injured by flash burns at even greater distances. Gamma radiation danger does not extend nearly so far, and the neutron danger zone is still more limited. High skin temperatures result from the first flash of high intensity infrared and ultraviolet and are probably as significant for injuries as the total doses that come mainly from the second, more sustained, ball of fire.

Effectiveness against personnel. For personnel in the open, within one-half mile of zeropoint of the airburst detonation, death would occur almost instantaneously or within a few hours from the blast, heat, and radiation effects. Within a radius of one-half mile and one mile from zeropoint, some persons would die instantly, while a majority would receive varying degrees of injury. Ordinary houses and structures would suffer complete destruction or extensive damage and fires would be widespread. Outside a radius of one mile and within a radius of two miles from zeropoint, personnel would suffer injuries from flash burns and indirect blast effects. Outside a radius of two miles and within a radius of four miles, personnel would be injured by flying fragments and suffer superficial wounds. Structures would be half or partially destroyed within this radius. In an airburst explosion 70 percent of those exposed would suffer from trauma, 65 percent from burns, and over 35 percent from radiation.

The radiologic hazard. In general, any radioactivity that remains in the area as fission products or induced radioisotopes will constitute a hazard. Fission products from the airburst bomb may be dispersed in the ground or spread out over wide and diffuse areas, depending on the technique employed in the detonation. Consequently, the degree and extent of residual radioactivity would depend on the height of detonation, climatic and meteorologic conditions conducive to the showering of the products on a specific area, and the nature and composition of the terrain. For example, because of the height of the detonation, certain prescribed areas of the bomb crater might remain hazardous. Also, because of the composition of the ground, dust particles intermixed with fission products might rise in the cloud. Many of these "dust particles" might also become radioactive as a result of neutron bombardment released at detonation and thus contribute to the hazard.

When the bomb is detonated over a modern city that contains countless thousands of items composed of iron, zinc, copper, and other "neutron capture materials," it is possible that many of the elements within the effective neutron

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range may become radioactive for a considerable period. The half-lives of some of these common elements and the radiations emitted are listed in table I. Therefore, objects or material that might survive the detonation, such as medical supplies containing sulfur or arsenic, should be handled with caution until the degree and extent of the induced radioactivity is determined. In some cases, it is possible that fission products also are present and are adhering to the material. In an underwater burst the main hazard, following detonation, will be the result of the deposition of a large percent of the fission products in

TABLE I

Partial List of Some Common Radioisotopes that may be Produced by Neutrons Released at Detonation

Radioisotope	Half-life	Radiation
Sodium–24	14.8 hours	Beta, gamma
Sulfur–35	87.1 days	Beta
Calcium–45	180 days	Beta, gamma
Iron–59	47 days	Beta, gamma
Cobalt–60	5.3 years	Beta, gamma
Copper–64	12.8 hours	Beta
Arsenic–74	16 days	Beta, gamma
Gold–199	3.3 days	Beta, gamma

the water and on nearby objects. In addition, radioactive sodium is formed by the action of neutrons on the sea water. Some of the more persistent and hazardous fission producers of U–235 are listed in table II.

TABLE II

*Partial List of Fission Products of U–235**

Fission product	Half-life	Radiation
Strontium–89	53 days	Beta
Strontium–90	25 years	Beta
Yttrium–91	57 days	Beta
Zirconium–95	65 days	Beta, gamma
Columbium–95	35 days	Beta, gamma
Ruthenium–103	42 days	Beta, gamma
Ruthenium–106	1 year	Beta
Cadmium–115	44 days	Beta, gamma
Cesium–137	33 years	Beta, gamma
Barium–140	12.8 days	Beta, gamma
Cerium–141	28 days	Beta, gamma
Cerium–144	275 days	Beta
Neodymium–147	11 days	Beta, gamma
Europium–155	2 years	Beta, gamma

*Nuclei Formed in Fission: Decay Characteristics, Fission Yields, and Chain Relationships, survey prepared by J. M. Siegel et al., J. Am. Chem. Soc., 68:2411–2442, Nov. 1946.

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The radiologic hazard can be divided into two phases. The first phase includes the immediate or prompt release of any ionizing particles or radiations caused by the explosion during the period of visible flash of the bomb. These prompt ionizing radiations include beta particles, neutrons, x-rays, gamma and alpha particles from unfissioned bomb residue, and the ionizing radiations from fission products. After the flash of the bomb has subsided, a matter of a few seconds, the delayed phase of the radiologic hazard is of importance. The hazard here is from fissioned and unfissioned material and from radioactive elements induced by neutrons from the explosion. The nature and persistency of the second phase depends on the technique of detonation. In addition to the phase of the radiologic hazard, the protection problem depends on whether the radiation concerned is external or internal to the body. Alpha particles, for example, present no external hazard; but if they are inhaled and become fixed in the bone, depending on the amount, the results may be lethal. Although very little can be done to protect personnel in the open within the lethal range at the instant of detonation, a few points in connection with the second phase may be useful. A comparison of radiations is given in table III.

The relative protection against gamma radiation by shielding, in order of effectiveness, is given by lead, iron, concrete, earth, water, and air. Using the gamma radiation from radium as an illustration, a 5 in. thickness of concrete

TABLE III
Comparison of Radiations

Nature	Description	Range		Ionizing power*
		Air	Tissue	
		Ft.	*Cm.*	
Alpha ..	Helium nucleus (2 protons and 2 neutrons).	0.1'	0.01	10,000
Beta ..	Electron emitted from nucleus ..	10	1.0	100
Gamma ..	Electromagnetic radiation from nucleus.	1,000	10.0	1

*NOTE: For each ion pair formed by a gamma ray, 10,000 ion pairs are formed by an alpha particle.

gives about the same protection as a 1 in. layer of lead. Where no shielding is available, "distance" is the best means of protection. It should be noted that neutrons pass through lead with extreme ease, but are readily absorbed by hydrogenous materials and boron.

The flash burn. At detonation, the flash burns from infrared and ultrared caused a higher percent of casualties than the radiologic effect, because of the increased range of the flash. Light shades of loosely fitting clothing, antiflash cream, and protection of the entire body surface will reduce the percent of casualties. Protection by these means will not reduce the effects of burns produced by secondary fires in buildings or facilities. The problem here is to minimize the amount of inflammable material as far as practicable. In this

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connection, materials that ignite easily should be avoided in the design of equipment intended for military operations. Flash burn is not a serious factor in an underwater detonation.

SUMMARY

Air-burst atomic bombs will produce lethal effects over an area of two square miles and measurable effect over an area of seven square miles as a result of the prompt gamma radiation emitted at the time of detonation. The residual radioactivity is of little importance except in the area close to the center of a low-altitude explosion. In an underwater detonation, radioactive fission products and unfissioned material will be spread by the cloud and base surge over a large area. The gamma radiation from these materials will be lethal to exposed personnel more than two miles downwind, and serious contamination will result at much greater distances. This contamination will provide a serious hazard for an indefinite period. Prompt evasive action at the time of the detonation will permit the reduction of casualties, and orderly evacuation and re-entry procedures will undoubtedly pay great dividends in minimizing the effects.

V. Fundamentals of Radiation Pathology

THE pathologic effects of radiation can best be presented by outlining the early and late changes in (1) tissue cells, (2) organ systems, (3) total body irradiation, and (4) internal radiation by radioactive materials introduced into the body either accidentally or therapeutically. Sensitivity of the various body tissues has been well established, and has been expressed largely as the relation of one tissue to another. Table I shows the relative sensitivities as indicated in two studies.

TABLE I

Relative Radiosensitivities of Various Body Tissues Listed in Decreasing Order

Desjardins*	Warren**
Lymphocytes	Lymphocytes (and germ cells).
Granulocytes	Granulocytes.
Epithelial cells	Epithelium.
(a) Basal cells of secretory glands	Smooth muscle.
(b) Basal cells of testes and ovarian follicles	Fibroblasts and drivatives.
(c) Basal cells of skin and gastrointestinal tract	Neurons.
(d) Alveolar cells of lungs; bile ducts	
(e) Tubules of kidneys	
Endothelial cells	
Connective tissue	
Muscle cells	
Bone cells	
Nerve cells	

*Desjardins, A. U.: The Radiosensitiveness of Cells and Tissues and Some Medical Implications, Arch. Surg., 25:926–942, Nov. 1932.

**Warren, S.: Histopathology of Radiation Lesions, Physiol. Rev., 24:225–238, Apr. 1944.

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Reactivity of the tissues in terms of energy or actual ionizing effect from a quantitative standpoint is somewhat less definite. Variation in response to ionizing radiation has been indicated in numerous studies, but becomes of particular interest in total body radiation, since in this circumstance the variation is not only a question of death or survival over a relatively broad range of radiation dosage, but also manifests itself as well by variations in organ responses, presumably by an equally wide range in symptoms and clinical findings. The effects of ionizing radiation are considered at present to be similar for all types of radiation—alpha, beta, gamma, x-ray, and neutron sources—when equal amounts from the standpoint of energy and time relationship are absorbed in the tissues.

Tissue cells. There is no satisfactory indication of any tissue effect of radiation other than destruction. In prolonged exposures of animals to tolerance and slightly higher levels, survival rates were higher in the exposed groups than in the controls. This same tendency was noted in weight curves. The exposed animals showed weights consistently above those of the controls, mostly from abdominal fat. This was considered not to be a castration effect. From a morphologic standpoint, however, the purely destructive effect has been emphasized in a recent report by Bloom.[1] It is well to keep in mind that it is unlikely that all tissue has been subjected to the ionizing action of radiation. Microscopically, any one or all of a number of cellular changes may be observed, such as: (1) changes in staining characteristics, usually an increase in eosinophilic properties; (2) increased granularity, usually of cytoplasm; (3) vacuolation of a variable degree; (4) swelling of cellular components; (5) distortion of cellular structures; (6) cytolysis (loss of definitive borders); (7) pyknosis; (8) changes in Golgi's apparatus; (9) reduction in mitotic activity; (10) production of abnormal mitoses; (11) chromosomal changes (fragmentation, clumping); and (12) increased refractile neutral red staining bodies within leukocytes seen by vital staining methods. These changes are found in conditions other than radiation, and although highly suggestive are not specific. Alterations in the noncellular tissue may include intercellular edema, swelling and hyalinization of colloid, and swelling and fragmentation of elastic tissue. A more direct approach to the cellular changes is found in observations on cellular viscosity, ciliary action, phagocytosis, cellular secretions, and a few enzyme systems that can be demonstrated. Alterations in these processes have been described following radiation.

Initially no changes may be found. Alterations in viscosity and slightly increased acidophilic staining properties are among the earliest findings. Cessation of mitoses and destruction of lymphocytes may occur in a matter of hours or less. Vascular dilatation and edema may follow, and, in the case of larger doses, actual necrosis of tissue cells may occur, again depending on the relative sensitivity. These represent only the readily demonstrable changes, and are certainly an inadequate and relatively crude index of the tissue alterations.

[1] Bloom, W.: Histological Changes Following Radiation Exposure, Radiology, 49:344–348, Sept. 1947.

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In small or moderate doses recovery may occur with no residual lesion, may show the frequent pattern of repair by fibrous tissue replacement, or, in other instances, may show the pattern of repair characteristic of the organ. There is no indication that the features of repair are specific or characteristic for any or all types of radiation. References to "radiation fibroblasts" and "radiation dermatitis" lead one to assume that these are peculiar to radiation injury, although such is not the case; but these designations are useful in evaluating tissue damage and probable etiology. The recovery stage in terms of tissue repair is often a matter of months or years and, in the case of repeated or continuing exposure, becomes a much more important problem.

The late effects, in most instances involving repeated exposure to radiation, are well established and include: (1) atrophy and ulceration of the skin, telangiectasia, fibrosis, and vascular occlusion, which were early recognized as radiation effects; (2) carcinoma of the lung, which in the Schneeberg mines was considered to be due to the radioactive material present in the inspired air; (3) bone sarcoma developing in persons ingesting radium; (4) carcinoma of the skin as a late effect of repeated exposure to x-rays; (5) leukemia, which has an increased incidence in those exposed to repeated radiation; and (6) other effects such as genetic variation and shortening of the life span.

Lymphoid tissue. Changes in the lymph nodes have been described by many investigators. Relatively small doses produce in a short time nuclear degeneration of lymphocytes and some distortion of the germinal centers. Congestion, swelling, and slight inflammatory cellular infiltration may occur. Mitoses are not seen until regeneration becomes active. Continued cellular degeneration is followed by increasing and active phagocytosis by large macrophages. Erythrophagocytosis occurs in addition to the phagocytosis of nuclear and cellular fragments. The inclusion of red blood cells in the macrophages is an early finding, the significance of which is not well understood. Repair following small doses is rapid and apparently complete. Somewhat greater doses result in a marked reduction in lymphocytes, leaving an almost empty reticular stroma with the persistence of a few small lymphocytes and a few larger reticulum-type cells associated with the germinal centers. Repair may take place, if the destruction has not been too great, apparently from the remnants of such centers, often with definite irregularity in the size, shape, and pattern of the lymph node. If the damage has resulted in almost complete destruction, the area may consist of more or less condensed stroma and loose connective tissue containing a few scattered lymphocytes. Such areas are said to offer no resistance to lymphoid circulation.

The spleen is less sensitive than the lymph nodes and regenerates less completely. A similar cycle of changes occurs. Loss of the lymphocytes may result in condensation of the stroma, and an accentuation of the reticular and sinusoidal pattern occurs. Regeneration, if it takes place, may show considerable irregularity in the cellular forms. Phagocytosis is active, and quantities of pigment may be present in the spleen after recovery. As in the lymph nodes, regeneration appears to proceed from the remaining recticulo-endothelial elements. The heavy accumulations of pigment have been interpreted as

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evidence of excessive blood destruction, or failure of splenic tissue to dispose of the material, or both. The thymus shows changes of a similar nature, although phagocytosis and disposition of pigment are not seen as in lymph nodes and spleen.

Bone marrow is more resistant to radiation than lymphoid tissue. Destruction of cells appears to involve both the immature granulocytic and erythrogenic forms. Regenerative changes are seen early, within the first week. Pigment deposits, eosinophils, and plasma cells may appear. With particularly heavy irradiation, almost complete loss of cellular elements may occur, with only a few reticulum cells and perhaps an occasional focus of erythropoietic cells. The marrow in such cases possesses a peculiar gelatinous appearance, grossly, with a deceptive red coloration arising from red blood cells within dilated vessels or dispersed extravascularly. Such marrow may regenerate adequately, or may result in an aplastic marrow with variable amounts of connective tissue. In the case of ingested radioactive material, any stage of hyperplasia or aplasia may be found, depending on intensity and distribution.

The peripheral blood picture does not indicate in adequate fashion the processes occurring in the marrow. For example, the apparent paradox occurs in which a hyperplastic marrow is present with a relatively low count in the peripheral blood, which is found in conditions other than radiation effect. In these cases there is usually some lack of maturation within the marrow. This introduces the question that has been asked a number of times in the literature: What factors determine whether a given hematopoietic system, when subjected to repeated demands, stimulation, or insults, will respond by hyperplasia or aplasia? Warren[1] cites the histories of two chemists working with radioactive substances over a period of years in the same laboratory. They observed no protective measures and died within five days of each other—one of aplastic anemia, the other of myelogenous leukemia. One can observe such cases clinically and encounter stages at which one is unable to indicate whether the case will progress to leukemia or to an aplastic anemia. Again this is not a situation peculiar to patients exposed to irradiation. Several well-known characteristics of radiation are shown by the marrow. One is the destructive effect on tissues elsewhere in the body, when exposure is limited to a relatively small area, another is the cumulative action of radiation. In successive exposures, the radiation necessary to show definite effects becomes less, and the periods necessary for recovery become longer. This has been expressed in the term "percentage recovery" for certain exposure.

Gonads. The reaction of the cellular elements of the seminiferous tubules to radiation varies. There is evidence to indicate that the primary spermatocytes are the more sensitive, contrary to the general statement that more primitive cells are more sensitive. Next in order of disappearance are the spermatogonia, small spermatocytes, spermatids, and spermatozoa, with the Sertoli's cells remaining and proliferating to replace the germinal epithelium.

[1] Warren, F.: Effects of Radiation on Normal Tissues, Arch Path., 34:443, Aug.; 562, Sept.; 749, Oct.; 917, Nov.; 1070, Dec. 1942; and 35:121, Jan.; 304, Feb. 1943.

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In other instances the spermatogonia, the most immature germinal cells, have been observed to be the only ones persisting. The interstitial cells have been generally regarded as resistant to radiation. The ovaries are less sensitive than the testes. Maturing follicles have been described as the most sensitive portion, and corpora lutea as relatively resistant. In mice, development of ovarian tumors following irradiation in the tolerance levels has been described.

Gastrointestinal tract. Edema and degenerative changes in the epithelial cells occur early. Subsequent changes may include hyperemia, hemorrhage, cellular changes progressing to necrosis, often with a thick superficial fibrin membrane, and subsequent ulceration. Mitotic figures and atypical cellular forms are seen within a week and are considered to be regenerative in nature, although closely resembling degenerated cells. These early epithelial changes in the gastrointestinal tract have been linked with the profound toxic changes. Connective tissue areas of the walls of the gastrointestinal tract show edema and myxomatous and hyaline changes, the same areas often containing bizarre connective tissue cellular forms. Later effects include fibrosis, atrophic changes in the mucosa such as reduction in the number of glands, and in the gastric mucosa a reduced number of chief cells. Ulceration is a relatively frequent occurrence after an extended period.

Respiratory organs. Pulmonary tissue is considered moderately sensitive to irradiation. A transient pneumonitis occurs, without apparent late effect. No significant changes have been described in the bronchial system.

Skin. The essential features include an early erythema occurring within a few hours to a few days, disappearing within a period of days, followed by a second occurrence of erythema ten days to four weeks later. This second episode represents the culminating pathologic change in the connective tissue and vascular bed of the corium, in contrast to the more direct injury to epithelial cells resulting in the early erythema. Pigmentation, epilation, and ulceration may follow with destruction of dermal glandular structures. Atrophy, hyperkeratosis, and telangiectasia may develop after repeated small doses without the preceding clinical manifestations and with the possibility of malignancy. The histologic picture is characteristic. The epithelium is thin, with obliteration of rete pegs. Irregular acanthosis may be present with cellular abnormalities. The corium shows dilated vascular spaces, atrophic skin appendages, dense and hyalinized collagen with variable basophilia, and reduced or absent elastic tissue.

Other organ systems. The epiphyseal region of infants and children is particularly reactive to radiation. In the eye, radioconjunctivitis occurs with moderate doses and may be followed by keratitis. Lenticular opacity occurs in young eye tissues with moderate doses, as compared with the greatly increased doses necessary in mature lenticular structures. Tissues that have not been discussed are generally in the less reactive range and undergo few changes except in massive localized exposure. To this group belong nerves, heart, liver, pancreas, bone, and muscle.

Total body irradiation. Doses used commonly, such as the erythema dose, approach or exceed the lethal dose when applied to the entire body. It is of

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considerable interest to define the changes at various levels of total body irradiation, and a certain clinical experience is available, as well as numbers of animal studies. Early and rather striking changes have been described in the gastrointestinal tract of animals dying of total body irradiation, with relatively slight changes elsewhere. Survival for a longer time places the organism in a period in which vascular damage and hemorrhagic phenomena are outstanding. The generalized destruction of hematopoietic tissue is a major factor at this and later stages. The findings at later stages are those of severe infection without adequate cellular response, and presumably without adequate resistance.

Internal radiation by radioactive substances does not involve any differences from the tissue reactions described, other than those associated with localization and intensity. The action of radioactive substances internally depends on (1) the activity of the substance ingested, whether an alpha, beta, or gamma emitter, and the duration of its activity; and (2) behavior in the body—rate of excretion, affinities for certain tissue, and its course of localization. For example, radioactive sodium-24, which is highly diffusible in the body, gives the pathologic picture of total body irradiation from an external source. The localization of many of the radioactive materials in relation to bone has intensified their effect. The lesions in radium poisoning may be used as an example—bone necrosis, particularly in the jaw, destruction of marrow with variable hyperplastic and aplastic changes, and the incidence of malignancy in the form of bone sarcoma. The amount of radioactive isotopes required to produce bone sarcomas, lymphomas, and the like in animals is practically identical with that required to produce perceptible effects in the peripheral blood.

VI. Pathologic Anatomy of Radiation Effects of Atomic Explosion

Before considering the radiation effects on the systems of the body, it is important to consider the relationship of lesions and time of death. In Japanese patients dying within two weeks after exposure there was histologic evidence of radiation in the bone marrow, gonads, gastrointestinal tract, and skin that was not manifested clinically. In the group dying in the third to sixth weeks, bone marrow changes predominated, while neutrophenic ulcers and hemorrhagic symptoms were very common. The general nutritional state declined. Gross changes were at the peak. Those dying in the third and fourth months showed beginnings of recovery in bone marrow and hair regeneration. Testicular and connective tissue changes remained evident. There was an increase in the number of emaciated patients. The poor nutrition was not based entirely on shortage of food. Intestinal lesions and other factors played an important part.

Skin. The quickly visible changes in Japanese affected by an atomic bomb were the pigmented areas that appeared in the first few weeks and persisted. These had such sharply demarcated outlines that they were considered as flash burns. Whether very soft, nonpenetrating gamma rays played a role has not been determined. Development of what we have recognized as ionizing ray skin burns was not seen. There were a few early cases of bullous

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edema that may have been from gamma rays. Epilation appeared mainly on the scalp, occasionally more on one side than the other; in the axilla in 16 percent; in the pubic region in 12 percent; and in the eyebrows in 8 percent.

Microscopically the hair follicles showed distinct changes both in the epidermal and dermal coats. Early specimens were not obtained, but in the fourth week the internal root sheaths could not be identified, the external sheath (continuous with the malphigian layer of the epidermis) being continuous with the hair shaft. Vascularity of the papillae was reduced, and the adjacent epithelium was atrophic. Pigment was irregularly clumped. The dermal coat showed thickening both of the inner hyaline membrane and the cellular fibrous layer. In pushing the base of the hair toward the surface a continuous shrinking in the bottom of the follicle occurred until regeneration took place with new cells over the papillae in a manner similar to ordinary hair replacement. There was also atrophy of the sebaceous glands, but this was also present when old hairs were replaced in the normal individual.

Some of the sweat glands were small, their cells occasionally vacuolated and pyknotic, and the basal membranes thickened. Evidence of radiation on the skin was not definite. Third degree flash burns could also be expected to have some radiation effect, but interpretation was difficult. At the edge of the burn area there was hyperpigmentation in basal cells and chromatophores. Some thinning of epidermis, hyperkeratosis, ironing out of papillae, and hyperpigmentation of basal cells were found in the scalp. Vascular and collagen changes were minimal.

Pituitary. Large basophilic cells with much cytoplasmic vacuolation appeared in 25 percent of the males dying in the third to sixth weeks. Because cells of this type are found in mammals after castration, they are known as "castration cells." In the second and third months large basophils were found, only a few being vacuolated.

Adrenals. In the first two weeks there was a loss of lipoid in the cortex, but in the next months the cortex progressively lost its orange-yellow color and was distinctly thin. Microscopically, most cells were granular rather than foamy, and the atrophy was most marked in the outer zona glomerulosa, contrary to what was expected. When foam cells were present, they were usually in the inner layer. The medulla was normal.

Heart. Epicardial petechiae were found within the first two weeks, and there was microscopic evidence of some perivascular and rare muscle edema in the myocardium. These changes continued to be present during the second month when myocardial hemorrhages were also seen. After the second month no distinct irradiation changes were found.

Lungs. Only the slight perivascular edema of the pleura that appeared in the first two weeks might be a primary radiation effect. Hemorrhagic and necrotizing pneumonia were common after the first weeks, as secondary lesions.

Genitourinary system. Except for hemorrhagic manifestation, there were no primary lesions in the kidneys and ureters. In the hemorrhagic stage of the radiation disease, mucosal hemorrhages in the bladder might result in necrotizing ulceration without evidence of leukocytic infiltration. The prostate and

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seminal vesicles were not remarkable, except for a rare neutropenic necrosis and the presence of a few spermatozoa that were morphologically normal in spite of the irradiation.

The testes showed intense changes in almost every cadaver. As early as the fourth day when the parenchyma had a normal appearance grossly, the histologic sections presented marked injury of the germinal epithelium, numerous cells of which were necrotic and free in the tubules and even in the rete testis. The number of mitoses was small. Sertoli's cells were increased in number. Mature spermatozoa were found even in later specimens with no spermatogenesis. Apparently uninjured spermatozoa appeared in the seminal vesicles. In the second month gross examination revealed little. A few necrotic germ cells remained, but most had disappeared, and phagocytic or infiltrating inflammatory cell activity was absent. A few bizarre cells still approximating the basal membrane appeared to be spermatogonia. Sertoli's cells were more numerous. The tubules had started to shrink. At this time also the interstitial cells of Leydig were so prominent that some interpreters considered them hyperplastic. Some of the small interstitial vessels showed the most marked vascular change of any part of the body. Beneath the distinct thin endothelium was an eccentrically located mass of eosinophilic, homogeneous, refractile material that almost occluded the lumen. This change was often best seen near the tunica albuginea and was present also in the third and fourth months. The interstitial tissue was less, but still prominent. The basement membranes were quite thick, wavy, and acellular. The tubules, more atrophic at this stage, were often hyalinized. Elsewhere Sertoli's cells had replaced the germ cells, which were rare. In the third and fourth months the state of nourishment was poor and specimens from the Dachau prison camp in Germany have been described as showing similar testicular changes.

Changes in the ovaries were much less striking. Gross changes, except as part of the hemorrhagic phenomena, were absent, even to the presence of a well-developed corpus luteum of pregnancy seen about the end of the first month after irradiation. Histologically, primary ova were usually present and only occasional specimens had a few atresic primary follicles. The absence of developing follicles was usual. There were no corpora lutea and the "resting phase" of the endometrium reflected this. Amenorrhea was distinctly increased in Nagasaki, and a significant number of abnormal births and an increased death rate of the mothers in relation to distance from the explosion were found there.

Gastrointestinal tract. This tract was one of the first to show gross lesions. Even before hemorrhagic manifestations the cecum or colon, particularly, might present a widespread change marked by swelling, green and yellow-gray coloration, and induration of the mucosa, sometimes with a pseudomembranous effect, and with much submucosal edema. Later mucosal hemorrhage might institute another cycle of similar change in the stomach or intestine. This change might begin with ulceration of the mucosa at the site of the hemorrhage and progress to a pseudomembrane or deep ulcer. Again, in the third and fourth months an enteritis, usually in the large intestine but sometimes affecting the

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small intestine and occasionally the stomach, might be the most prominent lesion. In the small intestines only the tips of the folds might first be involved. These looked at first as though they had been dipped in boiling water and then became green or yellow-gray. A few specimens of small intestine had a diffuse mucosal process. The large intestine in this late stage usually had a more widespread process that might extend from the ileocecal valve to the rectum. The thickened wall was characteristic. A pseudomembrane and ulceration were sometimes present so that the morphology was similar to that of bacillary dysentery. Much of the process here was not only an irradiation effect of the sensitive intestine, but also a result of the lowered local ability to cope with intestinal microorganisms and, probably more important, to the lowered antibiotic capabilities of the blood.

Microscopically the epithelium early contained extremely bizarre cells with giant hyperchromatic nuclei and multipolar mitoses. The swelling was seen to be from edema and the peculiar coloration from the absence of infiltrating leukocytes. Later, areas of mucosal ulceration with much fibrin, few leukocytes, and in the remarkably edematous submucosa quite a few histiocytes, a few lymphocytes, and occasional eosinophils were seen. Plasma cells of the lamina propria remained numerous.

Spleen. The lymphoid elements here reacted to radiation as in the nodes. Early spleens were usually small, but occasionally showed the early swelling reaction. On section, they were dark red and firm, the follicles were indistinctly seen, and the trabeculae were prominent. Besides the near absence of lymphocytes, large momonuclear cells were increased, and erythrophagocytosis and hemosiderin deposits were seen. In the second month the spleen was small and follicles were absent. There was a syncytial reticulum around the follicles in which the slight lymphocytic content of the organ was seen. Atypical large mononuclears were found in about 25 percent. Through the fourth month there was still some atrophy. Occasional germinal centers appeared, and the lymphocytic content showed evidence of recovery.

Lymph nodes. The high sensitivity of lymphoid tissue to ionizing radiation resulted in tremendous atrophy seen as early as the third day. Lymphocytes almost disappeared, leaving a lacy framework that was histologically spectacular. A similar picture was found in the tonsils and other lymphoid tissue. Changes in the germinal centers might be necrobiosis, but a departure from normal was not marked except when the germinal centers disappeared, as they did in three-fourths of those who died in the first two weeks. The early gross appearance of human nodes was not known, but bombed animals showed some enlargement, softening, and a paler color. By the second week large atypical mononuclear cells, considered by one observer as lymphoblasts, appeared. These cells logically could be pathologic forms whose sensitive nuclear chromatin was deformed by the radiation. About the fifth week, the nodes were usually small and almost devoid of lymphocytes and germinal centers. Bizarre large cells were more numerous. Plasma cells, eosinophils, and mast cells, along with increased numbers of reticulum cells, were present. Lymphocytes were more numerous in the fourth month but were still reduced.

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Bone marrow. The cellular picture of irradiated bone marrow was tremendously changed in the first week after the bomb explosion. There was almost total disappearance of blood-forming elements, excepting small islands of erythropoiesis, which were less sensitive. By the end of the week reticulum began to proliferate and differentiated first into lymphocytes and plasma cells rather than myeloid cells. This type of differentiation was predominant until the fourth week when myeloid differentiation was seen. Most marrows of those dying before six weeks were hypoplastic, but a few showed hyperplasia with arrest of maturation. Most of the fatal cases of the third and fourth months showed hyperplasia, which in the femur was grossly evident as pink marrow extending through from one-third to one-half of the shaft. In these the maturation defect decreased and more neutrophils were found in the peripheral blood and in infected tissues. A few of the older cases, however, showed aplasia with pink gelatinous femur marrow. Some grossly appearing hyperplastic marrows were really hypoplastic, the pink color coming from dilated blood vessels. Whatever the marrow picture, there was usually a profound leukopenia at some time in those dying in the first six weeks. Later leukopenia did not persist, and even those who died had leukocytosis except for the few that had aplastic marrows.

Miscellaneous. Only secondary hemorrhagic or necrotic changes were found in the brain. No changes were found in the pancreas, except for some mitoses in the islet cells. The presence of any irradiation effects in the liver is a moot point.

Secondary effects of radiation of reticulo-endothelial system. Hemorrhagic lesions and leukopenic necrosis affected the irradiated body about the end of the first month. The pharynx and its connections, the gastrointestinal tract, the respiratory organs, and the skin manifested both changes. In addition, particularly the urinary tract, mesothelial linings, muscles, and all soft tissues, showed petechiae, purpuric patches, or large ecchymoses. These changes were outstanding clinically. The severity depended on the location of the larger hemorrhagic lesions. Hemorrhages in the linings of the pharyngeal regions, of the bowel, or of the urinary tract gave signs externally. Large submucosal hemorrhages as well as petechiae appeared in the kidney pelves and in the bladder and sometimes in the ureters. Hemorrhages breaking through the epithelium of bacteria-laden surfaces often initiated the neutropenic ulcers, which in the pharynx were similar to acute agranulocytosis. Ulcers sometimes extended to the tongue, gums, buccal mucosa, lips, and even the skin to give the picture of noma. Such ulcers also began without hemorrhage. Bacteria ordinarily nonpathogenic might cause serious consequences through the loss of sufficient reticulo-endothelial reserves. Ulcers throughout the gastrointestinal tract were on a similar basis, as indeed, many of the diffuse mucosal changes might be. The necrotizing pneumonia appeared to be a part of this picture. There was little leukocytic reaction in these lesions, which overwhelmed the patient and led to death.

Case history. A 29-year-old man was at a distance of 0.7 km. from the explosion center. He was outdoors a few paces from a concrete building and

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was struck by a falling roof that inflicted slight head and neck injuries. There was nausea on 6 August 1945, and on the same day he vomited about 25 times. Malaise, accompanied by anorexia, began on 6 August and lasted until 10 August. He again experienced malaise from 21 August until he died on 1 September. Anorexia appeared four days after the second onset of malaise. There was epilation and gingivitis on 21 August, which persisted. The gingivae began to bleed on 30 August. On 25 August tonsilitis and purpura were noted. Both of these symptoms lasted until death. There was a high fever between 24 August and the time of death; and there was a productive cough beginning on 25 August with a hemoptysis on 30 August. The urine examined on 29 August was positive for albumin and negative for sugar.

Sections of marrow in this patient were hyperplastic, showing vascular adipose tissue crowded by a large number of young myelocytes. Mature polymorphonuclear leukocytes and even stab cells were rare. There was an occasional megakaryocyte. Occasional cells were found in mitosis. A few small cells with shrunken nuclei, thought to be normoblasts, also were found. Other important lesions at necropsy were: petechiae of the skin; epilation of the scalp; focal necrosis of the pharynx, tongue, tonsils, and larynx; necrotizing gingivitis; and abscess in the region of the right mandibular joint; necrotizing and hemorrhagic aplastic pneumonia; and minute hemorrhages of the gastro-intestinal tract, trachea, and renal pelvis.

VII. Detection of Overexposure to Ionizing Radiation

At present the potential sources of exposure to radiation include: (1) diagnostic and therapeutic x-ray units, (2) industrial x-ray machines, (3) radium and its degradation products, (4) cyclotrons, (5) the chain reacting pile, (6) radioisotopes produced by the pile that are being used in tracer studies, therapy, and as sources of heavy radiation for biologic systems, and (7) the atomic bomb and its fission products. It is apparent that the medical profession and public health authorities must take cognizance of the sources of exposure and endeavor to establish means of prevention and recognition.

Prevention is accomplished by careful measurement of radiation intensities by personnel film badges and radiation detection instruments whenever radiation may be present. Personnel should be followed closely for the presence of radioactive isotopes in nasal secretions, excreta, and on the skin. Where radioactive gases may exist, expired air should be monitored. In brief, overexposure to radiation should never occur. Since signs and symptoms are late, conditions conducive to excessive exposure should be detected by physical measurements before cellular damage occurs. In spite of this, protective regimens may fail, and in the advent of atomic warfare many will be overexposed to ionizing radiation regardless of precautions. Many earlier scientists learned of the hazards of radiation by tragic personal experience. The incidence of radiation burns, ulcers, and superimposed cancer in the early physicists and radiologists, the incidence of aplastic anemia in x-ray technicians, and the greater incidence of leukemia in radiologists point to the possible hazard of long, continued minimal radiation and potentially harmful cumulative effects.

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The effects of overexposure may be acute or chronic. The exposures may result from any type of radiation externally or internally applied. The clinical picture will depend on the amount, rate of delivery, and depth of the dose. Acute overexposure may be defined as a single total body exposure of more than 50 r. delivered within a period of a few hours. The signs and symptoms that may develop vary with the penetrating ability of the radiation and the amount absorbed. If the skin receives a large amount of soft x-ray or beta radiation, anything from a slight erythema to massive vesicle formation and destruction of its full thickness may develop. The injury will resemble thermal burns.

Similar cutaneous injuries can be caused by more penetrating radiations; but, in addition, other signs and symptoms such as diarrhea, nausea, vomiting, headache, anuria, purpura, and secondary infections largely caused by the leukopenia may develop. The latent period before the development of symptoms will vary with and be inversely proportional to the amount of radiation absorbed. The symptoms and signs will be directly proportional to the amount of radiation received up to the point that the latent period becomes so short that there is insufficient time before death for the entire picture to develop. The signs and symptoms of acute overexposure to penetrating radiation are variable. Although the best biologic index of overexposure to radiation is the blood, with the less penetrating external radiation the blood changes are less marked and may be absent.

The blood changes following acute exposures are fairly uniform if the exposure is over 100 r. The changes with smaller amounts of radiation may be missed if careful and repeated observations are not made at frequent intervals. There is, however, a uniform response to amounts over 100 r. that is roughly proportional to the amount received, up to a maximum response in the absolutely fatal dose range. The response is a prompt decrease in the total lymphocyte count that is detectable within a period of a few hours. The decrease attains a maximum within about seventy-two hours. Recovery may or may not occur, depending on the amount received. Another quite constant phenomenon is an initial neutrophilic leukocytosis caused by mobilization of the neutrophils and perhaps accelerated maturation and release from the bone marrow. It is reported by some workers that the leukocytosis does not occur with massive amounts of total body radiation (over 500 r.) in some species. The changes in the numbers of platelets and red blood cells and morphologic changes of the leukocytes are less certain and vary so much with the dose and the survival time that they will not be considered here. The acute blood changes can be summarized as follows: If no drop in the total lymphocytes is detectable in the first seventy-two hours, it can be stated with certainty that the exposure to radiation has been small and that serious illness will almost assuredly not occur.

The chronic overexposure to ionizing radiations presents an entirely different problem. The changes that occur are insidious and progressive. In fluoroscopists, radiochemists, or radium handlers the following may develop on the hands: (1) an increased brittleness and tendency to develop longitudinal ridges of the fingernails, (2) loss of integrity of the fingerprint by

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patches of atrophy, (3) impaired sensation, and (4) pigmentation. In general, as with the acute exposure, the blood is the best biologic index of overexposure to radiations. In order to evaluate the blood picture, some sort of norm for the average person must be established. This is most difficult, for the human blood is variable. Leukocyte counts of 4,000 to 16,000 are occasionally found in people who are in every other detectable respect perfectly healthy. The differential counts vary considerably with age and may remain abnormal for many months following infectious mononucleosis. Erythrocyte counts and hematocrit and hemoglobin determinations similarly vary widely. The time-honored normal values for hematological measurements probably include 80 percent of a given population within the upper and lower limits of the ranges given in standard textbooks. The 20 percent of normal individuals outside of this range will cause considerable consternation in a radiologic safety program.

How are blood changes that may be caused by chronic overexposure determined? First, base line counts should be established on all who may conceivably be exposed. The counts should be made at monthly intervals. Notations on the occurrence of colds, infections, and other symptoms should parallel the blood records. Relative changes in the blood of a given individual may then more readily be detected. The following hematological criteria for presumptive evidence of overexposure to radiation are offered and have been based on standard normal values and possible changes that have been described in the literature: (1) a depression of the leukocyte count below 4,000; (2) an elevation above 15,000 with an absolute and relative lymphocytosis; (3) a relative lymphocytosis with a low total count that returns to normal following removal from exposure; (4) an increased mean corpuscular volume, a shift in Price-Jones curve to the right, and an increase in the mean corpuscular diameter; (5) a reticulocytosis over 2 percent; and (6) an erythrocyte count over 5.1 million/cu. mm. and hemoglobin over 18.0 gm. percent. If any of the above criteria develop in a person who has a definitely established base line and who is associated with radiation, it is presumptive evidence of overexposure to radiation until proved otherwise.

Many other phenomena have been suggested as hematological evidence of overexposure. Changes in blood coagulation, prothrombin times, platelets, and morphologic changes in leukocytes, such as toxic granules, basophilic staining, and vacuoles (the toxic triad), have all been offered. It is exceedingly difficult to evaluate the importance and the diagnostic value of those changes. The evaluation of chronic exposure of any given individual in terms of changes within the blood cannot be made with absolute certainty. The following procedure may yield helpful information: (1) Remove the suspect from all possible sources of radiation. (2) Study breath, excreta, and nasal swabs for the presence of radioactive isotopes by making differential radiation counts. (3) Study the blood at weekly intervals and compare with the base line counts. (4) Endeavor to eliminate other factors, such as infectious mononucleosis, infectious lymphocytosis, virus diseases, benzol poisoning, and heavy metal poisoning. (5) Examine others that may have been similarly exposed and com-

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pare the base line mean leukocyte counts with the present mean counts for the group.

The fifth maneuver may yield more information than all the other blood changes combined. If a statistically significant difference in the means of the leukocyte counts of a group of people can be demonstrated during known chronic exposure as compared to the base line means, particularly if the difference shows a downward trend, it can be stated with some assurance that there has been chronic overexposure to radiation. The development of the above presumptive signs in the mean leukocyte counts for a group must be considered as evidence of overexposure until proved otherwise. The main bulwark of protection from radiation must remain physical control and measurement by established monitoring procedures.

VIII. Public Health Aspects of Atomic Explosion

It is hard to think of a group as other than made up of individuals. It is equally difficult to regard the individual without giving some consideration to the fact that he is a member of society. Public health is that branch of medicine that deals with the relationship of the individual to the community and of the community to the individual. At present the emphasis is shifting from the absence of disease to the presence of health.

In the event of an atomic explosion the medical officer will be called on to assess the hazard and to advise the command accordingly. He will probably have the necessary physical findings supplied to him. The magnitude of the hazard will depend on many factors. The advice of not only the physicist but also the meteorologist, geologist, and oceanographer will be needed. In damp or rainy weather there is little dust, therefore ground contamination will not be as serious from an internal (inhalation) standpoint as it would be under dry conditions. In assessing the hazard, it must be kept in mind that external radiation is more easily dealt with than internal radiation. You can guard against external radiation, but you must prevent internal radiation. Decontamination of the skin, although at times difficult, is far easier than decontamination of the thyroid, lungs, or bone.

The common personnel monitoring devices are film meters, pocket ionization chambers, pocket electroscopes, and Geiger-Müller tubes. Area monitoring instruments include Geiger-Müller tubes, electroscopes, ionization chambers, film meters, and dust- or air-sampling devices. Let us assume that an area is contaminated. It may be contaminated with: (1) Alpha emitters. This will constitute a most serious hazard if such substances gain access to the interior of the body. There will be no external radiation hazard. (2) Beta emitters. This will constitute both external and internal radiation hazard, which is more serious per unit if internal. (3) Gamma emitters. Here again we must think of both external and internal hazard, which is more serious from a practical standpoint if external. (4) Contamination. Contamination will almost certainly not be limited to one of the above types of radiation.

Food. It must be assumed that all food found in the area is dangerous. The food may contain induced radioactivity. This is unlikely to be present in

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dangerous quantities, because of generally unfavorable conditions and because of the short half-life of many substances. The medical officer will, however, probably be called on to give an opinion in these cases. Radioactive substances will most likely have been deposited on the food. In this case decontamination will be impractical or impossible. Canned or otherwise protected foods may be eaten only after careful inspection and most rigorous attention to detail in removing the food from the protecting agent. If it is necessary to bring food into the contaminated area, a high degree of laboratory precision, comparable to aseptic surgical technique, must be maintained in the handling of it. Smoking should not be allowed, as the handling of tobacco adds one more hazard.

Water. If possible, no water should be drunk in the area. If canteens are to be taken in, troops must be drilled in the matter of drinking without contaminating the mouth of the canteen by wiping. If larger amounts of water must be taken in, this greatly increases the hazard. The water in an area may be contaminated as a part of the general area contamination or may have become contaminated upstream. What can be done about decontamination? (1) Boiling is useless and may be harmful. It is unlikely that all contaminants will be volatile. Boiling will then serve only to concentrate and increase the contamination. (2) Storage, although useful for short-lived isotopes, is impractical for field operations and of little benefit for long-lived isotopes. (3) Filtration offers some promise and it is especially hoped that experimental work will point the way to practicable means of field application. (4) Chlorination and other chemical procedures are useless. (5) If we can combine precipitation and filtration, we may greatly reduce the load on precipitation. Here again, methods must be developed that are applicable to field use.

Prevention of dissemination by personnel is often of great importance. The underlying principles are always the same and may be illustrated by a discussion of the evacuation of an area. A decontamination center for area evacuation should be set up near the border of the contaminated area and all traffic in and out of the area controlled. Facilities must be provided for personnel entering the contaminated zone to remove all clothing, especially outer clothing, and change to overalls, hat, gloves, and boots. All food and tobacco should be left behind. Efficient monitoring is essential. On leaving the contaminated zone, personnel remove hat and gloves, wash face, neck, and hands throughly five times with soap and water, remove remaining clothing, and then soap and thoroughly wash entire body five times. The monitor located in a room between the shower and the uncontaminated side gives permission to go to the "clean" side and put on "clean" clothing. Laundering facilities for contaminated clothing must be provided. Shoes will present a difficult problem for evacuees leaving the area.

One may work with any amount of radioactive material if proper precautions are taken; but one cannot work with even the smallest amounts without proper precautions. Troops should learn to appreciate without hysteria the dangers of exposure.

(*To be concluded*)

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Clinical and Other Notes.

A NOTE ON MALIGNANT DISEASE, ITS DISPOSAL AND TREATMENT IN THE ARMY

BY

W. A. D. DRUMMOND, O.B.E., F.R.C.S.

One morning twelve years ago a "gunner" walked into the Out-patient Department of the B.M.H. Rawalpindi with a carcinoma of the cervical lymph nodes. He was examined, documented, boarded and entrained on the midday mail *en route* for the United Kingdom via Karachi. A.H.Q. Simla was signalled to provide an air passage, they replied that the Air-line would not accept such a case, but a passage on an express P. & O. boat had been arranged. Another air-line was asked and agreed to provide his passage within two days and Simla was informed accordingly. The "gunner" was home and under treatment within five days. Even in those days fairly rapid evacuation home could be arranged.

The position to-day may be illustrated by a recent case at the Central Medical Board of the Royal Air Force. The President of the Board, having assembled his Panel, said, "Gentlemen, the first case this morning is that of A.C.2 Blank with a teratoma of the testicle; he arrived at Wroughton yesterday by air from Singapore."

President: "Good morning Blank, have you any documents?"

A.C.2: "Yes, sir, here are the duplicate copies of my case history." He hands the President a sealed envelope.

President: "You had a testicle removed?"

A.C.2: "Yes, sir, I have it here." He undoes his haversack and takes out a screw-top bottle with a specimen in it and hands the bottle to the President. Pause. "I have also two slides of the tumour but am sorry to say that we had a bad bump on landing at Malta and they broke in my pocket." He hands the President an envelope containing two broken slides. "But I have also the 'Blocks'." He takes a packet containing the "Blocks" from his pocket and places them on the table.

He was examined and then followed a discussion as to the best form of treatment in his particular case; arrangements were made for his admission into Westminster Hospital, for radiotherapy, on the same day.

The handling of this case undoubtedly shows all-round efficiency. Whether or not it is wise to extirpate a malignant growth without prophylactic radiation is a matter still under consideration. The same view is held by many surgeons with regard to biopsy.

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The clinical diagnosis, the most important factor, having been made, the surgeon must decide if the carrying out of a confirmatory biopsy is an added risk to the patient and if the immediate removal of the growth offers the patient all the advantages that a modern centre combining radiotherapy and surgery can provide. Surgeons must as a rule in the best interests of their patients come to the conclusion that less risk is involved by rapidly evacuating a case to such a centre.

All army cases of malignant disease arriving from abroad are now referred to The Queen Alexandra Military Hospital, Millbank, for registration, disposal or treatment. Under the Director and Consultant Surgeon, a close liaison with the Radiotherapy Department of Westminster Hospital has been built up and along with this development there is now a library of case-histories, notes and photographs of the cases passing through The Queen Alexandra Military Hospital.

The Director and Consultant in Pathology has also formed a register at the Royal Army Medical College of all biopsies. Each case is registered with the history, the histological slide and the block from which the section was cut.

The histopathological opinion is checked. Should there be any doubt concerning the section, it is referred to the Honorary Consulting Pathologist to the Army or to the "Panel," a body of the most eminent pathologists in Great Britain, for their considered opinion.

The Disposal of Cases of Malignant Disease

Immediately, on admission, the case is checked over and a summary case sheet is made. The patient, together with his case sheet, X-ray, slides and blocks, is taken to the Radiotherapy Department of Westminster Hospital for a joint consultation. The whole aspect of the case is considered and should further opinions, e.g. orthopædic, oto-laryngological or, hæmatological, be deemed necessary, they are obtained if possible on the same day in order that a decision may be made and treatment started. It frequently happens that the patient leaves the consultation to walk into the therapy room for his first treatment. Should it be considered that the patient requires, primarily, a surgical approach, the case is placed under the care of the appropriate specialist at Millbank.

For patients with lesions of the upper respiratory passages, radium applicators and obturators are frequently required. For such skilled and important work the co-operation of the Royal Army Dental Corps is readily available. The standard of design and craftsmanship of the obturators, etc., made in the dental laboratory at "Millbank" have been acknowledged as second to none.

Delays do occur and are most often due to patients arriving at the centre with incomplete notes and reports, etc. It can be tragic if a biopsy has been taken and no section, blocks, etc., are sent with the case as delays in treatment may result while waiting for the report or repeat biopsy. The patient usually realizes that someone has slipped up.

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After consultation a few cases desire to be sent to an institution nearer their homes. This is invariably agreed to and copies of the case sheets, etc., together with consultation reports and recommendations, are sent to the hospital elected by the patient.

A number of these cases are now being returned after treatment to full duty but it is necessary to keep a close watch on the case during treatment and have a very careful follow-up. It has therefore been found to be more advantageous both to the patient and the service if the follow up can be done from the Therapy Centre where the Army has a liaison, so that should there be any untoward symptoms of recrudescence of disease, the patient is assured of immediate admission and treatment.

Methods of Treatment used on Military Cases during the Past Year

Teleradium Therapy.—" The Bomb " has been used with success on cases of carcinoma of the larynx, nasopharynx and maxillary sinus. The application is made through a number of ports by a jig adapted to fit each case in order to obtain accurate direction of the beam on to the growth.

High Voltage X-ray Therapy.—This has given beneficial results in Hodgkin's disease and reticulocytosis. Most of these patients were returned to duty.

Radium Needling.—Needling was used in carcinoma of the tongue and rodent ulcer.

Palliative Therapy H.V. X-ray and Teleradium.—Teleradium was given in cases of lymphosarcoma and osteogenic sarcoma and carcinoma.

The Outcome of the Liaison.—During the past year, from one Department of The Queen Alexandra Military Hospital, 15 cases of malignant disease were taken for consultation and therapy ; of this number two have died, one is still under treatment and the remainder have been returned to duty.

This is an exceptional result and difficult to repeat.

Under the ægis of the Westminster Hospital Radiotherapy Department, the field for the treatment of malignant diseases has been opened up for the Army. No longer are our malignant cases handed over to other hospitals for accommodation and treatment.

In all this work the Army Medical Service is most fortunate in having the enthusiasm, friendship and help of Air Vice-Marshal Sir Stanford Cade, *K.C.B.*, *C.B.*, F.R.C.S., M.R.C.P., Dr. F. M. Allchin, Mr. Stanley Lee, Dr. C. W. Wilson, the Physicist and Miss Wheatley—the team of the Radiotherapy Department of Westminster Hospital.

Gladly we avail ourselves of their very welcome co-operation, their joint consultations, their loan of radium, the facilities for H.V. X-ray and teleradium therapy.

Thus to-day, it is a common sight in the wards of " Millbank," cases with radium and radon implantations, cases undergoing teleradium and X-ray therapy pre- or post-operative, or definitive, or to see one or more of the Westminster Radiotherapy Team in " Millbank " giving us their advice and assistance over these difficult yet most interesting cases.

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WHILE modern chemical research has evolved many and diverse analgesics, the popularity of acetylsalicylic acid and its reputation for effectiveness remain. Nevertheless, some physicians have hesitated to employ it owing to its tendency, in certain conditions, to irritate the stomach.

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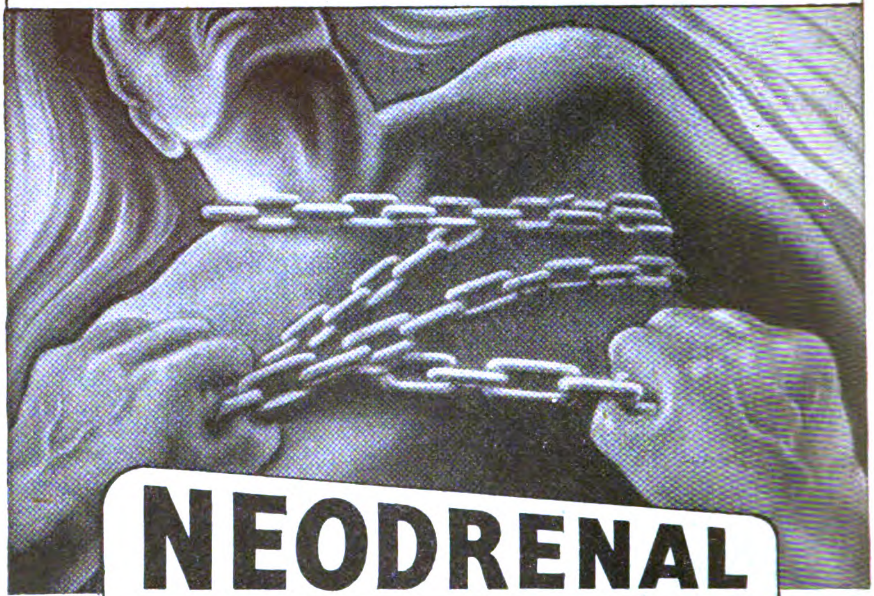

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SOME OBSERVATIONS ON AMŒBIC DYSENTERY

BY

R. V. COXON, M.D.

Late Major Royal Army Medical Corps

THE cases covered in this report were encountered among soldiers and airmen in India during 1943 and 1944, at which time the incidence of amœbic dysentery—and still more the apparent frequency with which it resisted treatment—were causing grave concern in that theatre. There was no unanimity as to the best therapeutic approach and in most hospitals a sufficient number of refractory cases had been seen to raise doubts as to the efficacy of many of the conventional remedies. It was deemed desirable, therefore, to make an attempt to determine which, if any, of the various therapeutic régimes advocated in different publications could offer, under the locally prevailing conditions, a reasonable prospect of cure without at the same time imposing an excessive strain on the available nursing resources. Thus, the primary object in assembling this series of cases was to compare a number of drugs which already enjoyed an established reputation as anti-amœbic agents ; but it was felt that the opportunity should also be taken to observe for a short period the course of the infection in a small group of cases treated only by such general measures as rest and a bland diet.

SELECTION AND GROUPING OF CASES

(1) *Diagnosis.*—The diagnosis was reached in all cases by the finding of vegetative forms of *Entamœba histolytica* in the stools or in material obtained at sigmoidoscopy.

(2) *Selection of Cases.*—The cases considered were all primary cases, that is to say, were receiving treatment for the first time. This criterion was adopted largely because of the difficulty of being certain of the previous history of any other cases both as regards the accuracy of the original diagnosis and also the details of the previous treatment, since (owing to movements of

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units and the great distances involved) it often happened that the only accessible source of information on these points was the verbal account given by the patient.

(3) *Grouping of Cases.*—Apart from the overall restriction of the series to primary cases, in regard to the group receiving only general treatment (Group V) a further bias was introduced by confining it to those cases showing sigmoidoscopically demonstrable lesions; this was done in order to secure as much information as possible from each case, but, as will appear later, the bias arising from this source was probably negligible. Otherwise allocation among the groups was in simple rotation.

(4) *Treatments Given.*—All patients were given diets of the high-protein-low-fat type approximating closely to those recommended at the Tropical Diseases Hospital, Calcutta, for stage five in the treatment of sprue (Napier, 1946).

The drug treatment given to the various groups is indicated in Table I. Emetin (0·065 grm.) was administered as the hydrochloride by deep subcutaneous injection; emetin-bismuth-iodide was given orally as a powder derived from crushing a tablet preparation, the daily dose (0·2 grm.) being invariably taken late in the evening. In the majority of cases the first dose of E.B.I. induced a marked degree of nausea which was presumed to imply that it was being satisfactorily absorbed; in that event subsequent doses were preceded by either phenobarbitone (0·065 grm.) or tinct. opii (1 ml.) whichever appeared from trial and error to be the more soothing to the particular patient. For quinoxyl retention enemata, 250 ml. of a 2·5 per cent. (w/v) solution in water were used. The enema was preceded by a wash-out with 2·0 per cent. aqueous sodium bicarbonate solution, and during its administration the patient lay on his left side. After the full volume of fluid had been run in he took up the knee-elbow position for the next five minutes before changing to the right lateral position for a further five minutes. Finally he turned on to his back, the foot of the bed was raised and this position was maintained (the chest and head being supported with pillows) for the next eight hours. Most patients successfully retained the enema for this period; those who failed retained theirs for at least six hours. The Group V cases, who received isotonic saline in lieu of quinoxyl, retained the same quantity of fluid and the accompanying ritual was the same. The solution of quinoxyl used was not sufficiently radio-opaque for skiagraphic confirmation of its localization in the colon, but experiments with other fluids of greater density and comparable viscosity gave conflicting evidence on this point. Whereas in some cases the postural gyrations of the patient did seem to result in some movement of the fluid into the ascending colon, in others it simply pooled in the rectum, so that one was left in some doubt as to what happened in any particular instance. Shortage of film and other limitations made it impracticable to determine whether the behaviour of the enema was constant for any one subject. Experience with cases outside this series suggested, however, that the use of larger volumes of enema-fluid or pressures greater than the 18 in. of solution customarily employed might help in reaching the proximal colon.

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Table I.—Schemes of Treatment

Group	Treatment	Days
Group I	Emetin 0·065 gm. o.n.	1–6
	EBI 0·2 gm. o.n.	7–12
	Quinoxyl p.r.	5–14
	Amibiarson 0·25 gm., b.d.	13–25
	EBI 0·2 gm. o.n.	20–25
Group II	EBI 0·2 gm. o.n.	1–10
	Quinoxyl p.r.	1–10
	Quinoxyl 0·25 gm. orally, morning and evening	1–31
Group III	Emetin 0·065 gm. o.n.	1–6
	Amibiarson 0·25 g.m. b.d.	7–17
	Emetin 0·065 gm. o.n.	9–16
Group IV	EBI 0·2 gm. o.n.	1–11
Group V	Aq. dest. 1 ml. n.	1–6
	Sod. Bic. 0·5 g.	7–12
	Saline p.r.	5–14
	Glucose 1 g. b.d.	13–25
	Sod. Bic. 0·5 g.	20–24

o.n. = nightly p.r. = rectally b.d. = twice daily

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Attempts to by-pass the recto-sigmoid junction by introducing the enema through a tube inserted high up under endoscopic vision yielded uncertain results.

Amibiarson (Martindale, 1941) was given by mouth in the form of tablets, the dose being 0·25 grm. morning and evening, and oral quinoxyl was in the form of an aqueous solution of which two doses, each containing 0·25 grm. were given daily. Of the surrogates supplied to Group V, sodium bicarbonate was in tablets and glucose in solution.

Results

(1) *Tests of Cure.*—All cases, after completion of their treatment, were subjected to the following tests of cure.

Specimens of 6 stools passed at intervals of not less than twenty-four hours were examined for trophozoite and cystic forms of *Entamœba histolytica*, direct microscopy of preparations in saline and in iodine being employed. Sigmoidoscopy was performed also and the patient, provided that the results of the tests were negative, then proceeded to a Convalescent Depot, where, for the next three weeks, he lived on normal Army rations and took part in rehabilitating exercises, including route marches. At the conclusion of the three weeks he returned to hospital where a further 3 specimens of fæces were examined at daily or greater intervals ; another sigmoidoscopy was also carried out at this stage. The patients were thus under careful surveillance for a minimum of five weeks after completion of their treatment, during three of which they lived under conditions approximating to those of the units to which they would be returning. Owing to various administrative considerations most of the cases were actually watched for six rather than five weeks.

(2) *Classification of Results.*—A case is recorded in the table as a " success " if, at the conclusion of the period of surveillance described above, no evidence of recurrence had been obtained. The results, on the basis of this criterion, are set out in Table II. The cases there listed as " doubtful " were some who, for operational reasons, could not be observed for the usual length of time.

Table II.—Results

<table>
<tr><th>Group</th><th>Successes</th><th>Failures</th><th>Doubtful</th><th>Total</th><th colspan="2">Successes per cent</th></tr>
<tr><td>I</td><td>11</td><td>0</td><td>1</td><td>12</td><td>91·7</td><td rowspan="4">84·8</td></tr>
<tr><td>II</td><td>8</td><td>2</td><td>1</td><td>11</td><td>72·7</td></tr>
<tr><td>III</td><td>12</td><td>1</td><td>0</td><td>13</td><td>92·3</td></tr>
<tr><td>IV</td><td>8</td><td>2</td><td>0</td><td>10</td><td>80·0</td></tr>
<tr><td>V</td><td>1</td><td>7</td><td>1</td><td>9</td><td>22·3</td><td>22·3*</td></tr>
</table>

*It is assumed so as to minimize any fallacy in the statistical argument that the doubtful case in this group was a success.

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Incidental Observations

(1) *Frequency of Sigmoidoscopically Visible Lesions.*—It has already been mentioned that the presence of such lesions was a condition for inclusion in Group V. Among the other groups there were 9 cases showing ulcers from which *Entamœba histolytica* was recovered; 8 of these responded satisfactorily to the drugs administered, giving a proportion of "successes" which does not differ significantly from that in the drug-treated groups as a whole.

(2) *Concomitant Bacillary Infection.*—The stools of all cases were examined in the early acute stage for the presence of bacilli of the dysentery group. Culture was carried out on MacConkey's bile-salt agar or litmus-lactose-bile-salt agar, but the additional refinement of using desoxycholate media was not possible since this ingredient was not then available in India Command. Nine cases in all of concomitant infection with dysentery bacilli were discovered; details of their distribution among the treatment-groups, the variety of organism found and the ultimate outcome are shown in Table III.

Table III.—Concomitant Bacillary Infection

Group	*Case*	*Organism*	*Sulpha-guanidine*	*Result* (*of anti-amœbic treatment*)
I	(i)	Flexner	+	Failure
	(ii)	Flexner	–	Success
	(iii)	Flexner	–	Success
II	(iv)	Flexner	+	Success
	(v)	Flexner	–	Success
III	(vi)	Flexner	–	Success
	(vii)	Sonne	–	Success
IV	(viii)	Flexner	–	Success
V	(ix)	Flexner	–	Failure

Sulphaguanidine was considered to be indicated only in the presence of exhausting frequency of defæcation, severe tenesmus or marked constitutional upset (either singly or in combination), and these conditions were fulfilled in only 2 cases.

On several occasions amœbæ were seen moving among the cells of a typical "bacillary exudate."

(3) *Progress of Cases Treated by General Measures Only.*—Some observations on 3 of these cases are set out in Table IV; for purposes of comparison, some data derived from 2 cases (not taken from this series), in whom recurrent amœbiasis supervened despite drug treatment, are tabulated alongside. Following the preliminary period on non-specific treatment, the 9 cases in Group V were placed on either the régime laid down for Group I or that for Group II with these results: 7 "successes," 1 "failure," and 1 "doubtful." The initial period on non-specific treatment did not, therefore, appear to

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prejudice the chances of a satisfactory response to drugs administered later, but it cannot, of course, be inferred that the same would necessarily hold good for an individual leading an active life and taking an unregulated diet.

Discussion

(1) *Validity of Recorded Results.*—It must be admitted at the outset that the period of observation following treatment in this series of cases falls short not only of the ideal, which in this connexion is somewhat ill-defined, but also of what has been advocated as a practical routine by many authorities. Thus Craig (1944) advises that " a check should be made of the stools once a month after the elimination of the infection for a period of at least three months." However, while the period of five weeks adopted in the present series would not enable one to say with certainty that a particular individual would not be liable to a recurrence, there is a good deal of evidence to suggest that it would make possible a reasonably accurate estimate of the likely incidence of recurrences in the groups as a whole. This evidence is derived partly from the writer's own experience of an independent group of 29 cases of recurring amœbic dysentery where 25 of the recurrences revealed themselves within less than five weeks of the cessation of the preceding course of treatment, and evidence tending to the same conclusion is available from the reports of others. Thus Craig and Faust (1943) noted in another connexion that of 130 cases who received treatment with emetin under certain particular conditions 81 per cent had relapsed within forty days, and Svensson and Linders (1934) have collected figures which suggest that the examination of nine stools should bring to light 90 per cent of existing infections. On the other hand the examination of three isolated stools at monthly intervals as advocated by Craig (1944) would not be expected to reveal, judging from the data of Svensson and Linders, more than 40 per cent of existing infections ; incidentally, in considering the value of examining a single specimen of stool (which is a common practice at some out-patient clinics) it is chastening to recall the observation of Dobell (1916) that of 179 stools passed by 9 persons known to be harbouring *Entamœba histolytica* no fewer than 108 were found to be negative on microscopy, illustrating the intermittency of excretion of the parasite.

It should be emphasized that the word " recurrence " rather than " relapse " needs to be used in relation to the present cases since the investigation was carried out in an area of high endemicity where it was not possible to distinguish between recrudescences and exogenous reinfections. Despite much active propaganda directed towards good personal hygiene it must be recognized that the convalescent cases were exposed to a high risk of reinfection. Analogy with the experience of other observers would indicate that most of the " recurrences " were, in fact, " relapses," but the alternative hypotheses of exceptional susceptibility on the part of some individuals or even simple bad luck in contracting fresh infections cannot be dismissed on the available evidence.

Since, according to the figures given by Dobell (1916), the likelihood of

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reappearance of the protozoon after an unsuccessful treatment is considerable during the first week following its cessation, it is justifiable to take the total number of stools examined during the follow-up period together (making 9 per case in the present series) as a basis for estimating the likelihood of detecting infestation ; the probability of detection would then be, following the calculations of Svensson and Linders (1934), about 0·9, i.e. 9 chances to 1 in favour.

Less reassuring is the finding of Lamb and Royston (1945) who, in reporting a group of cases with a history of multiple recurrences, record that the proportion of relapses bore an almost linear relation to the length of the follow-up period, reaching the distressing figure of 91 per cent after nine weeks. In their series, however, the proportion of recurrences after five weeks' observation was 56 per cent, so that there is some justification for supposing that their material was much less promising than that composing the present series.

It is suggested, then, that the period of surveillance of the cases here reported was sufficiently thorough to reveal any gross discrepancy in the relative merits of the different régimes subjected to test.

(2) *Comparison between Groups.*—The most striking disparity of results between the groups is that revealed in the last column of Table II where the "successes" in the four drug-treated groups are together contrasted with those in the group not so treated. Such a disparity would have been expected to arise by chance only once in about 1,000 trials. Similarly the difference between any one drug-treated group and the control group (Column 6, Table II) is also statistically significant.

So far as could be determined, Rogers (1912) in his original clinical trial of emetin used as controls cases receiving the previously favoured remedy, namely ipecacuanha. A controlled comparison between cases treated with emetin and cases treated only by general measures does not appear to have been reported before ; circumstances such as those mentioned in the opening paragraph of the present paper as calling for such a trial, possibly had not arisen in the past. In fact, it will probably be thought by some that such a comparison was unnecessary in any circumstances, since presumptive evidence was so strong as to render the result readily predictable. However, rumours of emetin-resistance and the undoubted occurrence of refractory cases made the comparison appear warranted at the time the present series was collected.

The common factor in Groups I to IV as compared with Group V was the administration of emetin, either orally as EBI or by injection in combination with some other recognized adjuvant. The figures in Table II, therefore, would substantiate the contention that a course of treatment which either includes emetin orally as EBI or combines injections of emetin with amibiarson will exert more than a purely suppressive effect in amœbic dysentery. At first sight there would seem to be a difference between Groups I and III (which received emetin by injection) on the one hand, and Groups II and IV (who received it by mouth) on the other, but analysis shows that this is no greater than might be expected from chance alone, though the investigation of larger numbers of cases—as was originally planned—might have revealed

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some more definite differences in the effects of the various régimes. In this series, too, the figures show that no significant benefit was produced by the addition of quinoxyl retention enemata to the oral course of EBI.

As with the matter of recurrences, so in the matter of response to treatment, the present series of cases, investigated as they were in India, cannot be compared with other published series treated in the United Kingdom. In the first place, they were fresh cases, whereas most series dealt with in the U.K. had either been already unsuccessfully treated or else had remained untreated for some considerable time. Secondly, in addition to the greater risk of reinfection with *Entamœba histolytica* in India, there is also to be considered the much greater prevalence there of other agencies noxious to the bowel. It is not possible to produce statistics contrasting accurately the incidence of non-specific diarrhœa among Service personnel in India with that among the population of Great Britain, but it must be a common experience that while an attack of this in one or two individuals among a group in England is sufficiently remarkable to provoke vigorous complaints against the catering arrangements, in India a spell of freedom from such an occurrence was almost an occasion for a celebration. Now, Craig (1944) in discussing the therapeusis of amœbiasis with chiniofon, propounds his belief that the diarrhœa accompanying the use of this drug is "unless severe, beneficial as it helps to bring about the elimination of the amœbæ from the intestinal tract." In the light of this argument it is difficult to see how the parasite could ever become established in anyone living in India, but, in point of fact it is equally permissible to conjecture that the bowel disturbances referred to above may induce a lowered state of resistance in the intestinal lining and so render it peculiarly susceptible to attack by pathogenic amœbæ. Apart from vascular changes in the mucosa of the gut, the presence of diarrhœa may affect the pH of the intestinal contents, alterations in which are known to influence *Entamœba histolytica* at least in so far as its sensitivity to emetin is concerned (Laidlaw, Dobell and Bishop, 1928). Thus, although no clear relationship is yet established between the bowel affections which in the present state of knowledge must be designated "non-specific" and those, such as amœbic dysentery, whose ætiology can now be specified, the mere existence of the former does constitute an undoubted and possibly fundamental point of difference between cases treated in India and those treated in England.

With these limitations in mind, the conclusion suggested by an objective study of the findings in the present trial is that, for routine treatment, oral EBI, given in bed with hospital supervision and proper diet (as in Group IV)—followed perhaps by the ambulant taking of oral quinoxyl (as in Group II) for an extra precaution—or, alternatively, parenteral emetin, also given in hospital and combined with amibiarson by mouth, should prove satisfactory; while retention enemata, which are troublesome things, might be considered for special cases.

(3) *Complications.*—No instances of hepatitis or other remote complication were encountered among the cases under review, nor any instances of

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intoxication by the drugs used, but, since the employment of electrocardiography was restricted at that time to urgent cases owing to shortage of photographic paper, the examination of the cardiovascular system was limited to routine clinical procedures and was to that extent incomplete. In the maintenance of freedom from gross toxic reactions to emetin and amibiarson, the precaution of keeping all patients in bed during treatment with the former, and the provision of an ample diet during treatment with the latter, may possibly have been contributory factors.

(4) *Bacterial Infection.*—As will be seen from Table IV, the presence of simultaneous infection with dysentery bacilli did not affect to a significant degree the course of the amœbic disease. Sulphaguanidine was given too infrequently to enable its effect, if any, to be assessed, nor can any evidence be adduced regarding the suggestion of Stokes and Ransome (1945) that the administration of sulphaguanidine may suppress the excretion of amœbæ in the stools. Penicillin was not available in India soon enough to be incorporated into the present trial, but, as is now well known, considerable benefits have since been claimed from its use as a preliminary to specific anti-amœbic therapy (Hargreaves, 1945). The absence of any obvious deleterious effect of simultaneous infection with dysentery bacilli does not in any way invalidate the rationale on which the use of penicillin is based, since, as has been pointed out by Hargreaves (1945) the flora of the intestine includes many organisms which are sensitive to penicillin and which may play a part in producing or maintaining ulcerative lesions. No strictly comparative studies of cases receiving penicillin and otherwise similar cases not receiving the antibiotic have, so far as the writer is aware, been reported, though Wright and Coombes (1948) who employed it in selected cases conclude that its use constitutes a notable advance in the therapy of amœbiasis. The possible side-effects of antibacterial substances which suppress the growth of organisms synthesizing essential nutrients in the gut must not, however, be forgotten if massive or prolonged dosage is contemplated.

(5) *Sigmoidoscopic Appearances.*—Sir Leonard Rogers (1921) in his monograph on " Bowel Diseases in the Tropics " states in the course of a description of the morbid anatomy of amœbic ulcers that " if small, there may be no puckering or pigmentation around them so that they may heal without leaving any lesions which would be obvious at a rapid post-mortem examination although close examination, more especially of the cæcum, might lead to the detection of slight scarring with or without some pigmentation." Rogers goes on to say that he found evidence of ulceration in the gut of 49 out of 50 patients dying of liver abscess and suggests that " the single exceptional case may easily have been due to slight earlier amœbic ulceration, which left no obvious scarring." He does not state whether the single exception had or had not received treatment during life, but, in any event, it might reasonably be inferred from Rogers' description and from other accounts in similar terms that spontaneous healing of amœbic ulcers could occur. The recognition of this eventuality does, however, have an important bearing on the practicability

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TABLE IV.—PROGRESS OF DISEASE AS REFLECTED BY SIGMOIDOSCOPY AND LABORATORY FINDINGS

	Receiving no Emetin									Receiving Emetin						
	Case F 22			*Case F 24*			*Case F 80*			*Case R 16*			*Case R 51*			
Day	*Sig.*	*Stool*	*WO*	*Sig.*	*Stool*	*WO*	*Sig.*	*Stool*	*WO*	*Tr.*	*Sig.*	*Stool*	*Tr.*	*Sig.*	*Stool*	*WO*
1		Flexner EH		U++ EH	B M EH		U++ EH	. .				EH	Em		EH	
2	U++ EH									EBI	U++		Em			
3		f BM								EBI QRE			Em	Gr		
4		f M EH			EHC	B M E H				EBI QR		B M —	Em			
5		f M —			f EHC	B M —			—	EBI QR		f —	QR Em			M —
6			M —							EBI QR		f	QR Em			M —
7					pc	EHC			M pc —	EBI QR		M pc —	QR Em			M —
8						pc EHC			M —	EBI QR		f M —	EBI QR			M —
9			M —			pc				EBI QR			EBI QR			
10			NAD —		sf BM —					EBI QR		NAD	EBI QR			M —
11			M —		sf M EHC	EHC				EBI QR		M —	EBI QR			M —
12		Culture neg.	M —		sf M —	M pc —			M —	EBI QR		M —	EBI QR			
13					sf M					EBI QR			EBI QR			M
14				NAD								M	QR			M

18					—	
19				sf —		
20	NAD —	EHC		loose —	NAD —	
21			NAD —	sf —	EHC	
22		EHC				
23				B M EH		
24						
25			EH found on			U+ EH
26			47th day			

KEY TO TABLE IV

B : blood.
EBI : emetin-bismuth-iodide.
EH : *Entamœba histolytica* vegetative.
EHC : *Entamœba histolytica* encysted.
Em : emetin hydrochloride subcutaneously.
f : formed.
Gr : granular.
Ing : injected.
M : mucus.
NAD : no abnormality detected.
pc : pus cells.
QR : quinoxyl retention enema.
sf : semi-formed.
SIG : sigmoidoscopy
Tr : therapy.
U : ulcers :
+ moderately numerous and extensive.
++ very numerous and extensive.
WO : wash-out : in cases F22, F24, F80 and R51, the fluid examined was that from the alkaline wash preceding a retention enema.
— : microscopy carried out with negative results.

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of assessing response to treatment by serial sigmoidoscopic examinations. Manson-Bahr (1943) implies that this is a useful proceeding, and in a paragraph headed "The Sigmoidoscope as a Guide to Treatment" states that he has observed the lesions in various phases of amœbic infection and that they change considerably during treatment; thus, during a course of EBI together with rectal quinoxyl, epithelialization could be seen to have taken place within twelve days of the commencement of treatment and "in a short time it becomes a matter of difficulty to recognize the site of former ulcers." Hargreaves (1946) also alludes to the sigmoidoscope as a useful guide to treatment in cases having ulceration within its reach.

In the present series it was shown that, in 6 cases receiving no specific drugs, ulcers, which had been visualized through the sigmoidoscope and from which *Entamœba histolytica* had been recovered, disappeared within periods varying from ten to twenty-four days. The significance of this observation depends on the meaning to be attached to the word "disappeared." What happened beyond any doubt was that lesions consisting of sloughing ulcers several millimetres in diameter underwent such a marked change that they were imperceptible to the same observers after a matter of two weeks or less. In view of the statement by Manson-Bahr (1943) that the sigmoidoscopic lesions of latent amœbic infection may be "most difficult of detection to any but the most practised eye" the question must be considered whether the lesions noted in the present cases were replaced by other lesions which, though imperceptible to the observers on the spot, may have been discernible to a more practised eye; the answer to this question is unfortunately not known. Cropper (1945) maintains that the ulcers of acute amœbic dysentery are replaced as healing proceeds by small groups of what he calls "pin-point craters"—lesions which, though he says that they are not mentioned in the standard works, are quite adequately described, albeit in slightly different words, by Manson-Bahr (1943). Probably the key to the situation lies in the interpretation given to the appearances which succeed the acute lesion. The present writer and his colleagues had had, prior to posting overseas, relatively little experience of sigmoidoscopy and this had been confined in general to the detecting or excluding fairly gross lesions. In dealing with dysenteric cases we were therefore disposed to proceed from first principles and to accept as amœbic only those lesions from which we were able to recover *Entamœba histolytica* or those which resembled exactly those from which the parasite had been obtained. For the most part, written descriptions and textbook illustrations proved misleading except in regard to the grosser pathological changes, and although attempts were made to evaluate such findings as pitting and granularity (the presence of either was always noted and is excluded by the comment "no abnormality" in Table IV) the difficulty of securing absolutely normal control subjects in sufficient numbers effectively prevented any satisfactory classification of such appearances being achieved. The impression gained, however, was that the variations as regards vascularity, prominence of glandular openings and lymphoid follicles, and so on, could be quite considerable within the normal range, and that this range was com-

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parable with, though perhaps not so wide, as that found in the gastric mucosa. This qualification of the index of healing does not, however, invalidate the cardinal finding that radical changes in the sigmoidoscopic appearance with covering of ulcerated areas by epithelium can occur in the absence of any specific drug-treatment. This fact must, therefore, be taken into account in any endeavour to evaluate the results of treatment by endoscopy—especially as sigmoidoscopes are considerably more common than practised sigmoidoscopists. The persistence of ulcers after treatment does, of course, afford unequivocal evidence of failure in treatment, but the disappearance of ulcers does not necessarily imply a beneficial effect of therapy; it may represent simply a stage in the natural history of a persisting infection.

Summary

(1) A series of primary cases of amœbic dysentery seen in India and treated there by several combinations of anti-amœbic drugs is described, and the results are tabulated.

(2) Some data are presented from a group of cases treated initially only by rest, dietary control and colonic irrigation with sodium bicarbonate solution and normal saline.

(3) It is concluded that reasonably satisfactory results can be achieved by either oral EBI or parenteral emetin combined with an organic arsenical; no appreciable improvement in results was noted from the addition to these measures of quinoxyl retention enemata.

(4) Sigmoidoscopic observation of the control cases showed healing of amœbic ulcers in the absence of specific medication.

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INDIAN AIRBORNE REMINISCENCES

BY

Captain F. G. NEILD

Royal Army Medical Corps

PART I—AN R.M.O. IN IMPHAL

"RED light on" . . . the Dakota vibrated as it lost speed for its run in and, with the sandbanks receding beneath us, the dropping zone came into view through the open door. The ground chosen for the landing was a narrow tongue caught between the icy waters of the Kabul River and the Indus where they converged just above the fort at Attock. It was January and the night was cold, but a half-moon lit the scene as the men gradually assembled at the rendezvous. Within an hour of landing the Battalion was complete again, thus performing an operation quickly by night which, the new Divisional Commander[1] stated, they had been trying unsuccessfully to perform at home for some time. This drop was Phase 1 of the final exercise for Operation "Eagle," which was obviously to be for a combined assault at the beginning of 1944 somewhere down the Arakan Coast. Before Phase 2 could be started all aircraft were withdrawn, leaving the 50th Indian Parachute Brigade virtually high and dry. It was a terrible anticlimax and life appeared to hold nothing more than another hot weather training period in Campbellpur. Shortly afterwards we heard we were to go on advanced jungle training to Kohima. Where was Kohima ? After scrutinizing our atlases it appeared to be a small Naga town, miles from the Japanese.

The Brigade, less the 154th Gurkha Battalion which was remaining to complete its air training, left Campbellpur, N. Punjab, on February 24 by rail for Calcutta, which was reached four days later. As notice of departure had been rather sudden, the second dose of cholera vaccine had to be given during train halts. After leaving Calcutta on the 28th the Field Service Area was entered, this change being immediately noticeable by the fact that all the Indian Civilian train staff were in khaki, and one drew "batta."[2]

After a journey of twelve hours the riverhead at Sirajganj Ghat was reached. From this point there was an overnight journey in a river paddle steamer to Tistamukh, where, for some unknown reason, it was necessary to change into another steamer. Two days were spent in this one, basking in the sun, moving slowly up the broad Brahmaputra. Riverhead was reached at Pandi, where we disembarked at the same time as an American-trained Chinese battalion destined for the Ledo Road. The metre gauge Assam Railway was in the throes of reorganization, as it had just been taken over by the Americans, so it took nearly a day to reach Dimapur, the railhead, where the night was spent in the transit camp. Next day, packed like sardines in three-tonners, the remaining 40 miles to Kohima were covered by free

[1] Major-General E. E. Down, *C.B.E.*

[2] Field Service Allowance of one rupee *per diem*.

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running M.T. along the first part of the Manipur Road: the remainder of the distance to the Brigade's camp at Chakabama, 10 miles east of Kohima, was completed on foot. Here the 1st Battalion, Assam Regiment at Jessami came under command, while 50th Brigade came under the 23rd Indian Division who were in the 4th Indian Corps.

Within a week the 152nd Indian Battalion had moved to a position at "Sheldon's Corner" south-east of Ukhrul. About this time rumours of more than normal Japanese movements, in the Tiddim area, began to circulate. Our Intelligence Officer who attended a divisional conference came back to explain that it was just the normal seasonal movements. At midnight on March 16 we had orders to move by 0600 hours the following morning, so we packed all night, but at 6 a.m. were told to stand down at four hours' notice. Not until the morning of March 19 did we have orders to move, when with full scales of equipment the 50th Brigade, less the 152nd Battalion and 1st Battalion Assam Regiment, marched the 10 miles up three and a half thousand feet to Kohima. Here the Brigade was met by M.T. and driven the remaining 80 miles of the Manipur Road to reach Imphal at dusk. Everything was in chaos—the transit camp, where we were to have fed and spent the night, had moved. Rumours flew thick and fast—the Manipur Road was cut. This we knew was not true as we had just come down it. We did not know it, but all Sisters and other women's organizations had been motored out that afternoon. There was nothing else to do but dig in and await orders. Almost immediately one company was ordered up to Ukhrul, where rumours had it that the 152nd Battalion was in difficulties. Next morning we heard the incredible news that the two leading companies of the 152nd had been overrun. . . . Where had the Japs come from? If "I" was correct, they should be some hundred miles the other side of the Chindwin. The situation was roughly comparable to a Londoner being told that the Germans had appeared in Tonbridge and not by parachute either. The 153rd Gurkha Battalion was allotted twenty 15-cwt. Dodges to get as many men as possible up to Ukhrul. The Battalion "O" group, the two remaining rifle companies and a platoon of mortars, were transported some miles into the hills to the site where the 49th Indian Brigade had been prior to their withdrawal to the Imphal Plain. This was on a riverbed about 6 miles short of Ukhrul and completely indefensible. An uneasy night was spent there hearing firing and watching flames from Ukhrul where our leading company was destroying food dumps and stores. On the following day 50th Brigade H.Q. decided to prepare a defensive position on the neighbouring Sangshak Plateau where there were twin Naga villages. Tactically it commanded the road junction at "Finch's Corner" and had a prepared two-company position in which were the Kalibahadurs—a Nepalese State Force Unit. The disadvantage was that water came from four seepage wells which were all outside the perimeter. Here 50th Brigade H.Q., 153rd Battalion and 80th Indian Field Ambulance concentrated, while Rear Brigade H.Q. with "B" Echelon of units remained at Litan at the crossing of the Toubal river. Next day the remnants of the 152nd Battalion, and the rear party of 49th Indian Brigade

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consisting of the 4th/5th Mahrattas and batteries of each of the 9th Mountain Regiment I.A., and the 128th Jungle Field Regiment R.A., came in. Almost immediately the Japanese attacked violently and bedlam ensued. Renegade Indian troops with them were shouting " Cease Fire " in English, Urdu and Gurkhali, while British Officers were shouting even ruder things in reply. The village just outside the forward rifle company caught fire, and it was touch and go whether the company would have to retire, but at the critical moment the wind changed. The total perimeter was so small that the Battalion R.A.P. shared a flat piece of ground, about the size of a badminton court, with a section of mortars. However, the attack was beaten off. Every night the Japanese attacked, but were quiet during the day. All supplies were short, particularly water. Attempts were made to air supply, but the dropping was bad. It was maddening to watch two-thirds of the supply containers falling into the Japanese hands. On the fifth night, after a particularly heavy attack, the Japanese broke into the perimeter, and it was only after six hours of savage hand-to-hand fighting that they were thrown out. The position was now desperate—of 25 British officers in the 152nd Battalion who had gone jungle training to Ukhrul some fortnight before only 2 were unwounded and 18 had been killed. Water was gone, and there was no sign of relief. That evening just before stand to the news came. . . . That night the action was to be broken off and the Brigade was to retire to Imphal, some thirty miles away as the crow flies but many times that distance by the tortuous jungle tracks. About midnight the Brigade broke up into small parties carrying their own wounded, some of whom took ten days to reach Imphal. Arriving on the Imphal Plain, it was found that the north-east approaches were now blocked by the 5th Indian Division which had been flown in from Arakan. Rear H.Q. had managed skilfully to extricate itself with comparatively little loss, from being encircled at Litan, and had withdrawn through the 5th Division.

The Brigade now reorganized in " Catfish " Box near 4 Corps Keep. Apart from its casualties, all its heavy stores had been destroyed at Kohima, while those of " B " Echelon had gone up in flames at Litan. Here an observer from the Directorate of Air at G.H.Q.(I) arrived to confirm the rumours which had been filtering back to India regarding the fate of the Brigade. From now on we were to be kept very much on ice as there were practically no paratroop reinforcements in India. Brigade H.Q. took over three unattached Battalions to form a new Brigade. The 152nd Battalion awaited reinforcements, while the surgical team was sent to Bishenpur. One section of the Field Ambulance, attached to the 1st Battalion Assam Regiment, withdrew with them to Kohima and went through the siege there, while another was to be later parachuted, on to the lines of communication of Wingate's Force (3 Ind. Div.), to act as a medical staging post.

At the beginning of April Imphal was surrounded, while very bitter fighting was taking place at Kohima. During the middle of April the 153rd Battalion moved from " Catfish " Box to " Oyster " Box on the Imphal perimeter defences, where we came under the 17th Indian Division—" The

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Black Cats." Shortly afterwards we moved to the village of Sengmi, the most forward defended locality along the Manipur Road. At the beginning of May the Battalion came once again under the 23rd Indian Division and took over Nunshigum, a hill which commanded the north-eastern airstrip on the Imphal Plain. This hill marked the flood tide of the Japanese advance. From here, some three weeks previously, they had been flung off by the 1st/17th Dogras supported by tanks of the 3rd Carabiniers. The latter had advanced single file up a knife-edged spur along which it was impossible to turn—climbing nearly a thousand feet in about twelve hundred yards—a manœuvre which was almost certainly in no Tank Manual of instruction. The Battalion remained there for nearly a month receiving some 80 reinforcements, and during this time the monsoon broke. At the beginning of June, we moved across the valley to the feature running up to the Mung Ching, coming then under the 20th Indian Division. From here a column was sent into the Naga Hills, to be followed up eventually by the whole Battalion. At the beginning of August 1944, following the complete rout of the Japanese, the Battalion returned to India for further training in its normal rôle.

Climatic Conditions and Terrain

Imphal Plain in the Manipur State forms a plateau about eight hundred square miles and two and a half thousand feet above sea-level. It is surrounded by hills averaging four to six thousand feet in height, through which escape the four main roads, one from each corner of the plain, and it was at these exits that most of the fighting took place.

The cold nights of February necessitated battle-dress being worn, although drill was sufficient during the day. There followed a short hot weather spell from the middle of March to the middle of May, when the monsoon broke. (The annual rainfall at Cherrapunji is over 400 inches a year, the majority during the monsoon.) Fortunately a break in the clouds about every forty-eight hours gave the sun a chance to shine through and made it possible to dry all clothing and equipment. Humidity during the rains was high in the plains, but low in the hills. During the monsoon a great deal of the plain, being paddy, was under water.

Regimental Medical Organization and Medical Services

The R.M.O. had at his disposal a medical section of one Havildar and sixteen Riflemen who were trained in first aid and both water and sanitary duties. The main bulk of medical equipment was at Battalion H.Q., but each medical rifleman, with the companies, carried a platoon medical haversack and a stretcher or carrying sheet. The Battalion was definitely "hygiene conscious," and, after two years of continuous cross-country exercises, were well versed in the art of mess-tin cookery, foraging, individual water sterilization and first aid.

Immunization was given against smallpox, typhoid, paratyphoid, tetanus and cholera; reinoculation for the latter being repeated every four months.

Evacuation of casualties was through the nearest Field Ambulance and

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from there, back to Imphal. Here there were four I.B.G.H. and three C.C.S., each one admitting daily in turn. As all Q.A. and I.M.N.S. Sisters had been evacuated, and as most of the Field Regiments and the one Medium Regiment, were sited in close juxtaposition, they were not ideal places in which to nurse patients, so that, when possible, all patients were flown out within forty-eight hours.

Equipment

(*a*) *W.E.T. or A.F.G.*1098.—This was on altogether too lavish a scale. In fact, when the Battalion was on a manpack basis, it was impossible to carry all the allotted appliances. Stretchers then used were of a collapsible bamboo type which had been designed for use on the North-West Frontier. They were not a great success as the bamboo broke under heavy work. In the hills, carrying sheets were the most useful form of carrying appliances. They folded up small and could be strapped on the back of a pack, and bamboo runners could quickly be cut locally for them. Their disadvantage was that a Thomas splint with suspension bar could not be attached. Stretcher slings were also invaluable for getting wounded away "pick-a-back" off steep hill sides.

(*b*) *M.M.E. or A.F.I.*1248.—This was, also, on too lavish a scale, particularly with surgical instruments. Medical supplies arrived in bulk and had to be broken down into scrounged cigarette tins and lotion bottles to fit into the various manpacks and haversacks. This was an extremely wasteful method as medical supplies, unless properly bottled or tinned, deteriorated rapidly, particularly under monsoon conditions.[1] This point is particularly stressed by Young (1947). What is required is a light-weight waterproof metal container, the size of a pack, which opens out so that any particular drug or instrument may be removed without the whole pack having to be emptied out on to the ground. It would be in the nature of a large "Burroughs Wellcome" first-aid box. The Germans and Italians had such equipment—specimens are to be seen at the exhibition of captured enemy equipment at the F.T.C., Chatham.

(*c*) *Small Arms*.—At Sangshak each medical rifleman, apart from his personal and medical equipment, had to carry a Sten gun, a hundred rounds of ammunition and two hand grenades. The result was that, to all intents and purposes, he was immobile, unless, when stretcher-bearing, he dumped his arms—thereby leaving himself unarmed in emergencies. Apart from the implications of the Geneva Convention, this armament appeared irrational, particularly when it is considered that No. 1 of a mortar section was not expected to carry a Sten as well as the mortar barrel. When the Battalion reorganized at Imphal, the opportunity was taken to rearm the whole medical section with revolvers only. This question, however, was never settled, and during later preparations for further operations in the Far East, a return from revolvers to Stens was being made.

[1]This was recognized for mepacrine, and each soldier was eventually issued with a proper screw-top container, as previously unless he was very careful whenever it rained his mepacrine tablets became an amorphous mass.

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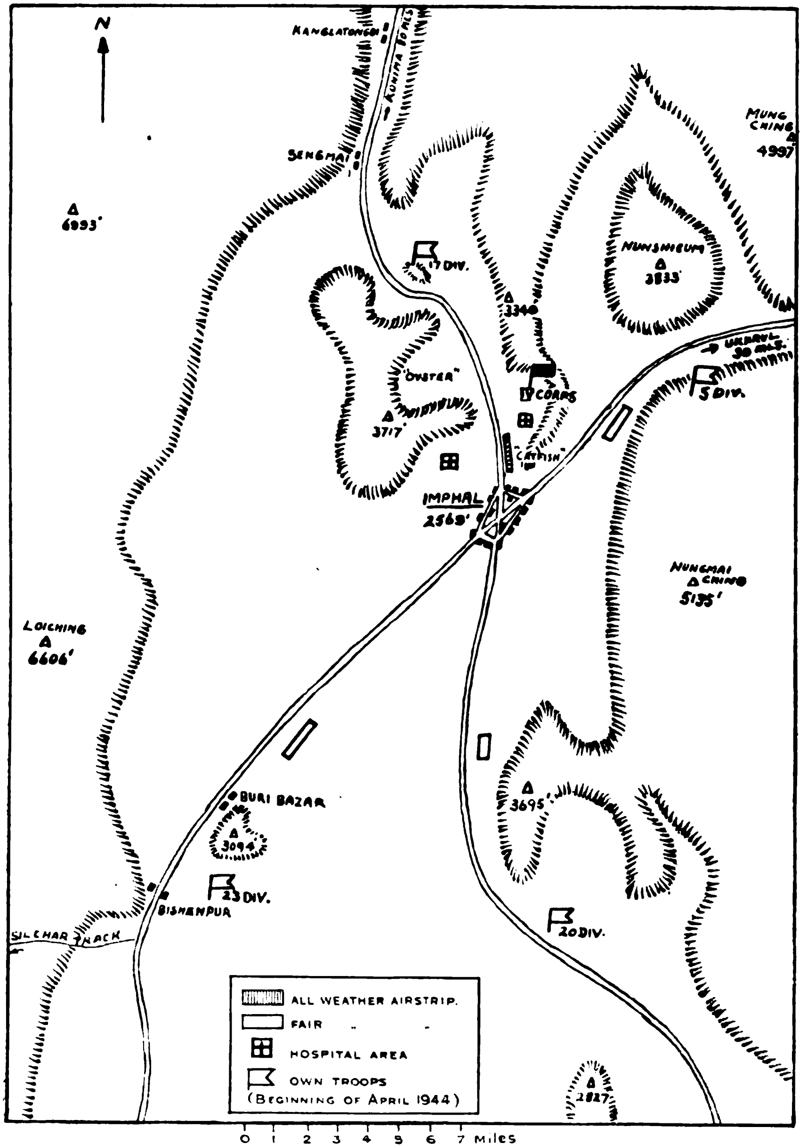
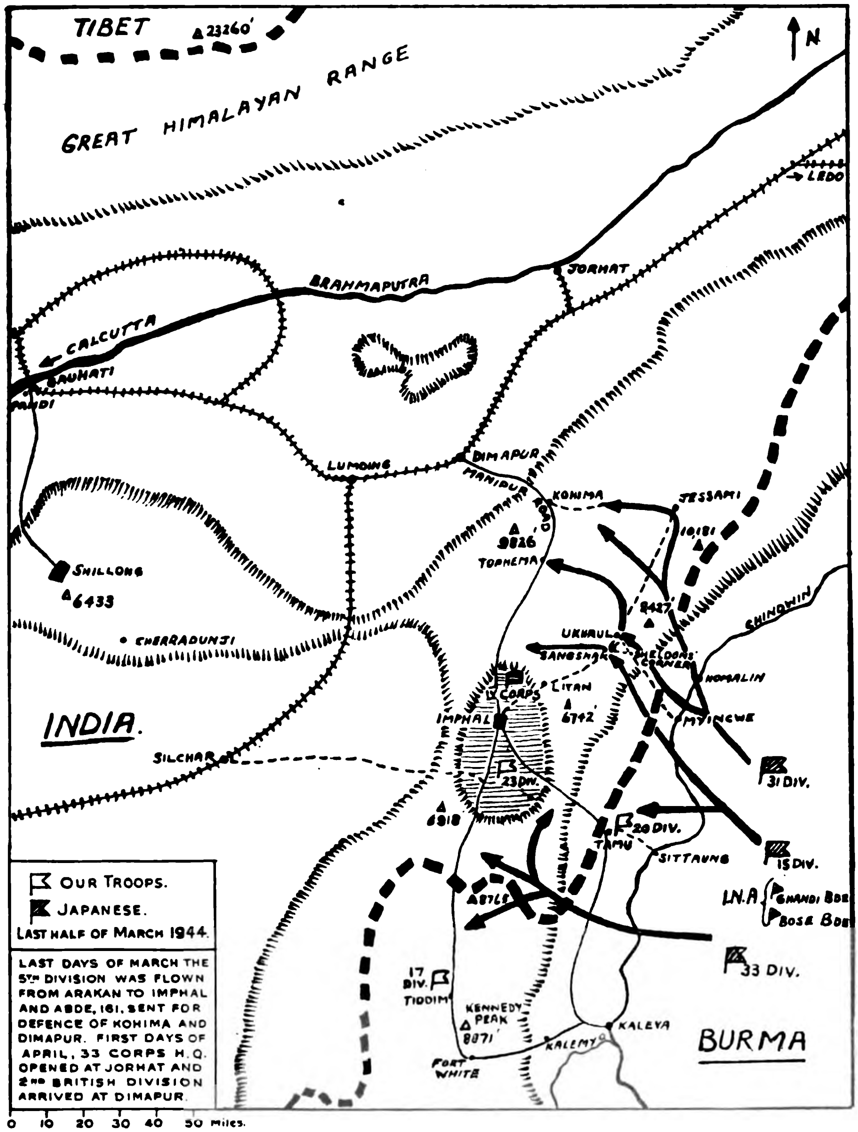
Clothing

Our arrival in this area coincided with the change from khaki drill to jungle green battledress. The blouse of the latter was most unsatisfactory as it nearly always shrank; leaving a gap above the trousers in the middle of the back, on which the bottom of the pack rubbed. This was later remedied by a change to bush shirts. Long sleeves and trousers, apart from the anti-mosquito protection, were instrumental in reducing the incidence of I.A.T. Incidentally, long sleeves and trousers help enormously in reducing the difference in appearance of white and dark troops. Socks at this time were



most unsatisfactory—reissues being the only ones available, the feet of which had been repaired with some sort of string material. They shrank immediately on becoming wet and the heel was always somewhere under the instep—not particularly pleasant on long marches. During periods when the feet were almost continuously wet, the old non-vanishing mosquito cream was found to be most useful as a foot salve. As grindery and dubbin were also in short supply, it was difficult to keep boots properly studded and supple. Short puttees were more effective than anklets in keeping the more persistent insects from one's stockinged feet.



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The regulation equipment is too tight and awkward for complete freedom of movement on long hill marches. We dispensed with the cross braces; ammunition bandoliers were slung around the waist; the water bottle was attached to the two buckles at the back of the belt and everything else carried in the pack, slung as a rucksack. An earlier lesson might well have been learnt from the Assam Rifles—a frontier military police—who had for some years past been very suitably equipped in their slouch hats, bush jackets and rucksacks with water bottles attached, for operating as mobile columns in these parts.

Personal Hygiene

Laundry facilities were non-existent, but it was nearly always possible to have a bathe in a stream about every ten days, following which the spare set of underclothing and drill was put on. The dirty clothing was then washed out and soon dried by the sun. Health inspections were carried out as often as possible and at least monthly. Although nominally for pediculosis and scabies, the chief lookout was for "jungle sores." These seldom developed due to the immediate first aid, which was given to all scratches, by the riflemen of the medical section attached to each company.

Water Supplies

The provision of water was no particular problem except in the hills. The methods used for sterilizing it were as follows:

(*a*) *For Patrolling.*—Riflemen were issued with water sterilizing outfits; if not available, recourse was made to superchlorination by the "master" water-bottle method.

(*b*) *For Static Purposes.*—R.E. water points were sited in each box, where the two-cistern method was employed, owing to the absence of any filtering equipment. Superchlorination was used, as there were no detasting tablets. Only rarely was alum available for sedimentation.

(*c*) *For Forward Units.*—Water was carried by mule pakhals and stored in cisterns of tarpaulins. Normally a five-day reserve was maintained in each perimeter area.

Rations

For the four months during which Imphal was besieged, all supplies were brought in by air. This resulted in an overall reduction in supplies so that rations, of necessity, had to be cut and many substitutes in the scale issued.

(1) *Individual Packs.*—Owing to the many ration scales in operation for the various classes of troops, there were as many individual packs available. When these packs were in short supply it was not always possible for the right pack to reach the right troops. In addition, troops fighting in the jungle, especially under adverse conditions, may have to use an individual pack for a considerably longer period than for which it was designed, and the longer this type of ration is in use the less palatable it becomes—some more quickly than others. Here the American "K" failed by its very specialization as its highly spiced processed foods palled rapidly. This criticism also applied to the Pacific ration. The Indian light-scale ration was of two varieties, milk or

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fish, depending on the religion of the troops. This ration was awkward for one man to cope with in one day. It contained a number of largish tins, the contents of which were difficult to eat at a sitting, and which were eventually difficult to dispose of without leaving a trace. If, on the other hand, the half-consumed tin was put back in the pack it usually made a mess of it and invariably attracted ants.

It always seemed a pity that the lines along which the original Indian Paratroop ration—Shakapara biscuit, compressed raisin and cashew nut, tea, sugar, dried milk, cigarettes, salt and a sweet made with an amaranth basis—had been developed had been given up following the evidence of the first Wingate expedition (1944). This ration, an early prototype of the twenty-four-hour ration, was palatable, nutritive, of a high calorific value, easily handled and could be eaten by troops of any Indian race, religion or caste, and finally whose packings were easily disposed of.

(2) " *V* " *Force Rations.*—These were packed in large drums and were not complete rations, but rather supplements, which provided the trimmings, to an otherwise monotonous diet of curry, for mobile columns based on local villages. For their purpose, these rations were excellent.

(3) *Field Service Scale.*—Due to the ration cuts tinned food-stuffs were in short supply; rice was issued in lieu of potatoes and Shakapara biscuits in lieu of bread, so that troops who wouldn't eat rice or biscuits must have suffered a severe drop in calorific intake. The lesson here is that troops must be accustomed to all types of food that are available in the country in which they are operating.

Local supplies of fresh vegetables, eggs and chickens were available at prohibitive prices from the Manipuris. Sometimes fresh meat could be obtained from local cattle, and, in the hills, from the domesticated wild pigs and hill cattle or mittaungs. For continual heavy hill climbing more than one ounce of salt per day is required.

Amenities

To " go to town " in Imphal one had the choice of visiting the Canteen Supply Depot (C.S.D.)—the equivalent of NAAFI—an Officers' Shop, a Transit Camp or the Y.M.C.A. All commodities were rationed and cigarettes were unobtainable except for an issue of some thirty to forty a week, usually " Vs," but sometimes as a special treat, " Woodbines." Newspapers were usually some days late and arrived in batches, and consisted of the publications "SEAC " and " Contact " of G.H.Q.(I). Noel Coward was the only ENSA artist to visit us during the siege. We had no radio, but if one was really hungry for news or dance music it was possible to tune the W.T. sets in to the All India Radio Station at Calcutta; but the one most eagerly awaited "amenity " was mail from home.

Accommodation

In Imphal and the surrounding villages troops were accommodated in requisitioned Manipuri huts or the speedily erected bamboo bashas, but elsewhere one lived for weeks underground in a " bunker," furnished with

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a roughly made bamboo bed. The two main problems here were to keep the "bunkers" dry during the monsoon and to prevent the excessive growth of fungi.

Sanitation

Latrines of the deep trench variety were used, and in the plains these had to be built up some three or four feet owing to the height of the subsoil water. Coverings for the men who squatted were made from bamboo, while the officers had sandbagged seats which were remarkably comfortable. Disposal of refuse and sullage followed accepted Army principles. Some units had very crude ideas of sanitation, as we found several times to our cost. For instance, at Sengmai, where food, when served, became immediately black with flies, it was discovered that it had been a static installations' area, from which troops had withdrawn, before the Japanese, without closing their deep trench latrines. Again at Nunshigum, which we took over from a British battalion, who had been there some three weeks since the recapture of the hill from the Japanese, the stench was appalling and multitudes of green-bottle flies, with pink noses, were found to be breeding in the three to four hundred barely buried Japanese corpses. Following the excavation and burning of these bodies the flies virtually disappeared.

Burials

Christians and Mussalmans were buried on the spot if it was not practicable to remove their bodies by M.T. to their own central burial ground in Imphal. Hindus were burnt.

A difference in outlook between ourselves and Hindus is illustrated by the following incident. One day one of our officers whilst out walking with a Gurkha, passed the lonely grave of a British soldier high up on a hillside. The Gurkha remarked that the soldier's spirit must be very angry. On being asked why, he replied "As he cannot fly home."

Health of Troops

The Battalion left Calcutta at the end of February 1944 and returned there about five months later. It entered the Field Service Area with some thirty-five officers, British and Gurkha, and a strength of just under six hundred other ranks. At Sangshak it lost four officers killed, four wounded, thirty G.O.R.s killed and some hundred missing and wounded. During the siege of Imphal its casualties were one officer killed, three wounded, twenty G.O.R.s killed, thirty-eight wounded and twenty-two evacuated sick. These last figures represent battle casualties of 5 per 1,000 per week, and sick of 3 per 1,000 per week, and are particularly striking as the sick are less than the battle casualties—this during active monsoon operations.

The Battalion's time of arrival in this theatre was fortunate to coincide with the universal issue of mepacrine and the supply of sulphaguanidine down to R.M.O.s. It was also lucky not to have had to operate in a scrub typhus areas as D.B.P. or D.M.P. were not then available. Another worry was "jungle sores." These, however, were almost entirely prevented by

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long sleeves and trousers which safeguarded against minor lesions, and immediate first aid, on the spot, was provided by the medical orderly in each platoon. The value of riflemen trained in medical duties with the leading platoons cannot be too highly stressed for the prevention of disease and the maintenance of morale, particularly in sub-units who are liable to operate isolated for days at a time in the jungle.

Antimalarial precautions were comprehensive, except for guards and patrols for whom face-nets and gauntlets were not then available. With Gurkhas there is not the difficulty experienced with British troops of getting them to take mepacrine. The reason is that as most of them have malaria as children, they were only too pleased to take anything which would prevent recrudescences of their old fever. Mosquito nets used were the little bush nets. At night before stand-to the tablet of mepacrine issued through " Q " channels was swallowed and mosquito cream applied while the medical orderlies would go round flitting the bunkers with pyrethrum (D.D.T. not then available). At that time the mosquito cream used was the vanishing variety.

When one was hot and sweaty it did not provide much protection, nor, in the low-lying parts, did the clothing prevent mosquitoes from biting through, particularly to the knees and elbows.

To conclude it is only fair to relate the epilogue, which could hardly have been bettered as a controlled experiment if one had wished to demonstrate the difference between a disciplined unit and a collection of individuals. Following the return of the Battalion to India in August, as most of the men had not had home leave for some three to four years because of the war, they were sent to Nepal on two and a half months' leave, which included a fortnight's travelling time. As from the railhead in British India, the Terai (a notorious malaria belt) and the foothills into Nepal had to be traversed on foot, each man was given ninety tablets of mepacrine. But when the Battalion began to reassemble in October it was heartbreaking to deal with sick parades of seventy, mostly fevers and " jungle sores " and to have some fifty in hospital with malaria, including cases of M.T. Yet within six weeks of returning to the fold, it was gratifying to see a fine unit rapidly regain its peak of physical efficiency.

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PART II.—A NOTE ON THE FORMATION OF AIRBORNE FORCES IN INDIA

The 50th Indian Parachute Brigade which formed in Delhi Cantonment in October 1941 consisted of the 151st British, the 152nd Indian and the 153rd Gurkha Parachute Battalions. In addition, there was a British-Indian Brigade Signal Section as well as a Sapper Section from the Kirkee Sappers and Miners. These Battalions were composite ones which had been started

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from scratch with volunteers from various sections of the British Army in India and the Indian Army. The Indian Battalion was the most interesting experiment, as it contained all races, creeds and castes. This had not previously been attempted and the experiment can hardly be counted as successful, for when the Airborne Division was eventually formed, the Battalion split into two—Hindu and Mussalman—by simple fission rather than by parthenogenesis. The British Battalion, first commanded by Lt.-Col. Martin Lindsay, *D.S.O.*, of Greenland fame, went to the Middle East in 1942, where it was renumbered 156th, assisted in the occupation of Taranto by 1 Airborne Division and later fought with that Division at Arnheim. The Gurkha Battalion had the smoothest passage in forming as it consisted of one class who spoke one language and was officered by British officers of the Gurkha Brigade. It was commanded at that time by the then Lt.-Col. F. T. Loftus-Tottenham, *D.S.O.*, who afterwards commanded the 81st West African Division.

When I reported to Brigade H.Q. in November 1941, the Brigade Staff was hardly an encouraging advertisement for any embryo parachutist. The Commander, Brigadier W. Gough, *M.C.* (late 2nd Gurkhas) with only one eye (having lost the other in the previous war) was hobbling around on sticks on account of a compound fracture of his leg sustained on his last jump at Ringway. The B.M., Major Hopkinson, *M.B.E.*, was in a plaster spica—he had broken his back when he made the first statichute jump in India with Lt.-Col. Abbott. *M.B.E.* (152nd Bn.) and Squadron Leader W. Brereton, A.F.C. (Chief Landing Instructor at the A.L.S.), and they had all been deposited on the concrete outside the hangers at Drigh Road, Karachi. Apart from the ordinary difficulties of raising, Brigade H.Q.'s problems were legion. It had all the difficulties of parachute training with the corollary of design and modification of equipment for which there were no precedents in India. Basic information in the secret file consisted of a very full German Operation Order captured in Crete and two pages from *Picture Post* of the German Airlanding School somewhere near Brunswick. At G.H.Q.(I) there was a single air liaison officer Major Misra Chand, who had flown pre-war in the Viceroy's Cup Air Race, while the Brigade Intelligence officer was Flt.-Lieut. Narendra, R.I.A.F., who had been on the first course for Indian Cadets at Cranwell.

The Airlanding School was at the Willingdon Airport, New Delhi. Although this was an R.A.F. Unit, all the parachute instructors, then, were from the Army. Equipment for parachute training consisted of twelve "X" type parachutes (or statichutes), an out-of-door trapeze and the "mock-ups" were the aircraft themselves, with the fuselage having a ground clearance of about three feet. Aircraft at that time consisted of a flight of Vickers Valencias, affectionately known as "Pigs" which were reputed to have been built about the year 1922. Courses lasted a fortnight with a previous one week's course of P.T. There were thirty men per course, and five jumps were necessary to qualify for "Wings." As there were only 12 "X" type parachutes in India it was necessary to use some of them twice a day; this was without any proper drying facilities such as drying sheds.

The Brigade's first composite exercise was to take part in the march past

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Generalissimo Chiang Kai-shek in February 1942. The latter had been invited to New Delhi in the rather forlorn hope of bridging the widening rift between the Imperial War effort and Congress. In March 1942 all air training ceased as the Valencias departed in the direction of Burma to assist the evacuation. Owing to the acute shortage of all types of aircraft in the East the continual withdrawal of our planes served as a depressing indication of our fortunes on that front. Shortly after the retreat from Burma the first operational parachute sortie was made—in June 1942 Major J. O. M. Roberts, *M.C.*, with a mixed party of British and Gurkha troops was dropped near Myit-Kyina to glean what information they could of future Japanese intentions. To retire, this party had to march north several hundred miles to Fort Hertz, from where they were flown back to India. The landing strip at Fort Hertz had been prepared by a party of Sappers dropped under the command of Major G. E. C. Newlands, *M.C.* In July a company of the Indian Battalion was dropped in the Sind Desert to help round up the Hurs—a lawless Mussalman tribe under the Pir of Pagiro. This, according to Field-Marshal the Viscount (now Earl) Wavell (1946), was probably the first use of parachutists in civil disturbances. On August 8 the Congress kettle, which had been bubbling for a long time, boiled over due to the arrest of Gandhi and other leaders in Bombay. The Brigade was immediately deployed for Internal Security in both Old and New Delhi to control tactical areas, where they remained for some four weeks. During these disturbances, the Gurkha Battalion had the great distinction of not firing a single shot—this during a number of potentially dangerous situations.

Owing to the increased importance of Delhi as a nodal air junction for the Burma theatre of operations, the A.L.S. was moved in October to Chaklala, in the North Punjab, where it became No. 3 Parachute Training School (P.T.S.) and an entirely R.A.F. commitment. For administrative convenience the Brigade moved into the same area with its base at Campbellpur, which was not far from the Indus at Attock. Here a third battalion, the 154th Gurkha, was formed from the remnants of the 3/7th Gurkha Rifles (one of the surviving units from the Burma retreat of 1942) to replace the British Battalion. In spite of the arrival of more aircraft—some Hudsons and a squadron of Wellingtons—the cold weather of 1942–43 was a depressing period owing to the number of unexplained fatalities. It speaks volumes for the morale of the Brigade that training went on in spite of the death-rate—about one per course. As courses then consisted of a hundred, this represented a one per cent mortality amongst would-be parachutists. One of these accidents which happily proved not fatal after a drop of nearly 700 feet was described by Neild and Mackenzie (1943). Eventually Group Captain Newnham (1947) came out from home at the beginning of 1943 and following his recommendations the accident rate rapidly declined.

Hot-weather training in Campbellpur was both trying on the temper, as the temperatures even at night did not drop much below 100° F., and wearing physically, as exercises which were entirely on foot were carried out over country which was mainly sandy soil. Owing to the low humidity there

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was no prickly heat as in Delhi, but due to the extreme dryness of the atmosphere quite a lot of nose bleeding occurred. The advent of cold weather 1943–44 was greeted with relief rather like the approach to an oasis after days in a desert. SEAC had been formed and the new Brigadier M. J. T. Hope-Thomson, *M.C.*, had just obtained a complete Wing of Dakotas. General Browning and Staff, including the A.D.M.S. 1st Airborne Division, Colonel Austin Eagger, *C.B.E.*, came to visit us and operations were promised in the New Year. The Brigade was being reorganized—mortars had been taken out of the rifle companies and concentrated in the support or heavy company and machine guns had been removed from the battalions and concentrated in a Brigade Machine Gun Company. The Sappers had been increased to a Field Squadron, 411 Parachute Squadron I.E., and a Field Ambulance, 80th Indian Parachute, in which a surgical team was incorporated, was raised. In addition, the Indian Airborne Forces Depot was formed to take the place of the Parachute Training Centre (P.T.C.) at Chaklala, where the P.T.S. was also situated. Intensive air tactical training was now carried out and, considering the language problem, excellent co-operation developed between this Indian Brigade and the Empire aircrews of the Dakotas. This was a problem indeed, particularly for Jumpmasters—for example, Gurkha "sticks" were counted out from one to twenty in English, whereas Indian ones were counted out from one to ten in Urdu and this count then repeated.

During this air-training period it was found that on day drops there was a half per cent of serious casualties and one per cent of mild ones, whereas at night these figures were about doubled. . . . Serious casualties were hospital admissions. These figures are higher than those of No. 3 P.T.S. quoted by Pozner (1946), but this is understandable as for air tactical training jumps the facilities for bivouacking and for "mock-ups" were meagre compared with those of the P.T.S., and, in addition, the dropping zone was strange to both air crews and jumpers. From an inspection of the Long Roll of the Battalion—this after two years of formation—it was found that there was a 33 per cent annual turnover in other ranks and a 20 per cent one in the case of officers. This was exclusive of battle casualties, but inclusive of failures on training and training casualties. The original volunteers consisted of riflemen with an average of five years' training, but later on recruits with as little as six months' training were accepted. During this period there was no training depot, so each battalion was a cosmos in itself, doing its own recruiting, but maintaining a training company at the P.T.C. The R.M.O. was, therefore, responsible for all initial airborne medical examinations, the health of the battalion, the training of its medical section and the rehabilitation of the injured. The latter was a heartbreaking task as there was, then, no hospital rehabilitation service for fractures, and by the time the majority of the injured came out of hospital attendant functional disability was usually complete. The subsequent return of disabled men, a liability to their families, was doubly troubling to our consciences as it was not until after two years of hard battling by the battalion commanders that a man injured on parachute training received a pension equivalent to that of a man disabled in action.

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Air training culminated in a three-weeks jungle training block course at Rai Wala near Dehra Dun. 153rd Battalion had the privilege there of doing the first battalion jump in India—this after an approach flight of four hundred miles from Chaklala. It was an unforgettable sight watching, for the first time, a Wing of Dakotas coming in on a bend of the Ganges and flying line ahead in flights of three, depositing the battalion group in a jungle clearing. It must have been a proud moment for the O.C., Lt.-Col. H. R. E. Willis when General Auchinleck[1] followed by General Giffard[2] strode across to the battalion rendezvous and greeted him with "Colonel, how magnificent." This drop, at the time, we fondly imagined to be the shape of things to come, but how soon our hopes were dashed and complete frustration almost set in. Shortly afterwards all aircraft[3] were removed, while the Brigade was converted to a mule-pack basis, and sent for advanced jungle training near Kohima. As little has been published about the early fighting in Imphal, and as from Owen's account (1946) it would appear that the Brigade was flown in to fight as reinforcements, the following extract of General Slim's Order of the Day (copy addressed to 50 Indian Parachute Brigade) published in the Field on August 31, 1944, is appended . . . "Your Parachute Brigade bore the first brunt of the enemy's powerful flanking attack and by your staunchness gave the garrison of Imphal the vital time required to readjust their defences."

In August 1944, the Brigade returned to India and joined its depot parties who had been moved to Secunderabad in Hyderabad (Deccan) some fourteen hundred miles from Chaklala. Here the new Airborne Division was endeavouring like a Phœnix to arise from the ashes of the 44th Indian Armoured Division. The projected plan was for the divisional units to come from the old Armoured Division, another parachute brigade to come from home and the airlanding brigade to be formed from an ex-Chindit one, while the divisional reconnaissance squadron was formed from the Governor-General's Body Guard[4] who had forsaken temporarily their chargers and lances for jeeps and brens. Meanwhile 50th Brigade was ordered to continue under ALFSEA with air training for the next phase of the 14th Army operations. This, however, was easier to order than to carry out, as it was soon discovered that the airfields around Secunderabad were unsuitable for Dakotas and an alternative site at Bilaspur had to be turned down for medical reasons. Eventually the Brigade was ordered back to Chaklala—bag and baggage—the complete fourteen hundred miles. This decision was only reached after the Brigade commander, now Brigadier Woods (late 1st/17th Dogras) and the Battalion commanders had each been summoned once or twice to G.H.Q.(I) to discuss future movements.

[1]Commander-in-Chief India.

[2]11th Army Group Commander.

[3]We were informed at the time that it was because of operations in Italy, but afterwards it was apparent that it was because of the Chindit operation.

[4]Their Sikh troops were the first in India to jump. Their late appearance in the airborne world was due to the difference of opinion between them and the R.A.F. with regard to suitable headgear for parachuting. Eventually a compromise was reached with the Sikhs wearing a sort of super knee-pad tied around the outside of their pagris.

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Air training proceeded smoothly at Chaklala until December when it suddenly ceased. Everyone wondered what had now gone wrong until it was discovered that the 14th Army advance had been so swift towards Mandalay that they had outstripped their ground Lines of Communication and had, in fact, overrun the dropping zone which had been planned near Shwebo for the Brigade at the beginning of February 1945. As it was not considered that further parachute operations could take place before the advent of the monsoons, 50th Brigade was split up to form the nucleus of two parachute brigades in the new Division. This decision was forced on the authorities in India as the 2nd British Parachute Brigade, which had been earmarked for the East, was now fully committed in Greece. The 152nd Indian Parachute Battalion was, therefore, split into two while two British Battalions, the 15th and 16th Parachute and the 77th Brigade H.Q. as well as the Pathfinder Company, were formed from what British volunteers were left after the disbandment of Special Force (Wingate). The Airlanding Brigade, the 14th Indian, consisted of the 2nd Black Watch, the 4th/6th Rajputana Rifles and the 6th/16th Punjab Regiment. The parachute battalions were now all renumbered as Indian or Gurkha Battalions of the Indian Parachute Regiment, which had just been formed with General Browning as first Colonel Commandant. A new type of Field Ambulance was formed, an Indian Parachute Field Ambulance (combined). It consisted of an H.Q. and five sections, two of which were British, and had all the disadvantages inherent in a hybrid organization. To each Field Ambulance were attached two Indian Mobile Surgical Units. While this reorganization was taking place it became suddenly necessary to mount a parachute operation to neutralize the guns at Elephant Point, which commanded the entrance to the mouth of the Rangoon River. This, although nominally a divisional operation, was the swansong of the original 50th Brigade, as a composite Battalion from its old battalions was formed and, under Lt.-Col. G. E. C. Newlands, *M.C.*, landed and carried out its appointed task. While the Battalion was taking part in the Victory March through Rangoon, news of the end of the war in Europe was announced.

The 44th Indian Airborne Division continued to form at Secunderabad under Major-General E. E. Down, *C.B.E.*, and for a period of two months (July and August) there was an Airborne Corps H.Q. in India—Commander Lt.-General Gale. The second division would have been the 6th Airborne Division from home. In June the 44th Indian Airborne Division was ordered to Bilaspur C.P. to begin air-training; here there was a group of air-fields which had been built following the Japanese invasion threat. This move was a classic example of one carried out in the face of strong medical opposition. It was vigorously pointed out that at Jhansi in similar terrain and under similar climatic conditions two years before, there had been a serious breakdown in the training of Special Force which had later adversely affected some of their units in the field. Bilaspur, near Nagpur,[1] was a highly malarious area which abounded in snakes, with a fairish proportion of kraits. As the Division was under suppressive mepacrine, malaria was, however, of little account. One of the

[1]Means literally the City of Snakes. It was one of the two hottest places in India.

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Brigades was encamped near Ratanpur, a site of an ancient Hindu civilization. Here filariasis was common and something like one in four of the inhabitants was an interesting walking pathological specimen. Owing to the high humidity of Bilaspur, and poor washing facilities, ringworm was rife. When the war ended training had virtually ceased as the majority of the British, half the Gurkha and some of the Indian troops were badly affected, i.e. their heads and bodies were covered with ringworm. The only bright note in this somewhat dismal period at Bilaspur was the end of the war and the Division having the privilege of supplying the majority of the parachute medical teams which were dropped in Siam, French Indo-China, Malaya and Indonesia as the harbingers of help to Allied prisoners of war.

Towards the end of the year the Division, now the 2nd Indian Airborne, was moved to the Quetta-Karachi area and concentrated once again on Internal Security duties. Shortly afterwards with the advent of Indian Independence, the British units were withdrawn from the Division and brigaded in the 6th British Independent Parachute Brigade, while the Indian and Gurkha battalions were disbanded. When last reported (1947), the 50th Indian Parachute Brigade under Brigadier Y. S. Paranjpe was fighting the insurgents in Kashmir.

The war ended before the Division could show its paces, but there had been both symptoms and signs that the airborne resources in India had been overstretched. Up to the end of 1944 it had not been easy to maintain reinforcements, of a sufficiently high standard for 50th Parachute Brigade, to cover normal wastage and training losses. The question might well be asked whether it is economical to lock up a highly trained specialist force for such long periods of time and also whether the air training, of such a large mass of troops as a division, is worth while, when the standard of proficiency which could be reached by such a group was low, especially as General Wingate had shown, troops could be trained for air transportation at almost a moment's notice. But it is probable that, for spearhead thrusts to seize the initial airstrips, a nucleus of trained paratroops will always be required. However, paratrooping in India was certainly not without interest. It varied from circus days in Delhi when the drop of each " stick " of parachutists was watched by a multitude of visiting Allied Generals and Indian Potentates, to footslogging across the plains of the North Punjab ; from being expendible in the thickets of the mountainous country of the Assam border to jungle training in the steamy wastes of the Central Provinces. But the real tragedy was, that when a fine precision instrument had been formed in the cold weather 1943–44, it should have been blunted in such a manner. It is interesting to speculate what would have been the outcome of the North Burma Campaign if the 50th Parachute Brigade had captured the Myitkyina Airfield—Exercise " Boggy " (1942)—at the beginning of 1944 and Special Force had been flown in there and not left to roam several months in the jungle.

I would like to thank Brigadier G. J. V. Crosby, *C.B.E.*, *T.D.*, late D.D.M.S. 33 Indian Corps for allowing me to peruse " Account of operations

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RETURN TO MERVEIL

BY

POZ

UNCHANGED by the years the diminutive station glinted like a newly painted toy in the harsh bright sunlight. Out in the courtyard where the tall palm-trees drooped lazily and the heat shimmered against the yellow adobe walls, Cæsar was stretched in an open-mouthed siesta over the front seat of his familiar brown Renault. Cocking one eye open at our approach, he smiled a broad, gold-toothed welcome, but casually as if it were only yesterday and not two years ago that the Garrison had paraded sorrowfully for the last time on the cobbled stones of the town square. That in itself was not surprising in this secluded corner of southern Europe where time is simply a figure of speech and coincidence is apt to be the commonplace.

Without any irrelevant questions he stowed away the luggage, and climbing into the car we started off on a sentimental journey. The road to the town skirts the northern shores of the Mediterranean. It climbs and dips and twists suddenly, but always it hugs the beaches, and on one side you see the Chateau Merveil crowning the Black Mountain, and on the other, stuck out in the middle of that blue, blue sea, a compact group of little islands which at night scintillate like the ships of a battle squadron.

I knew every inch of that road—the pot-holes, the pill-boxes and the shattered gun-emplacements. At this corner where the road runs by the edge of the salt-beds, the Germans fought desperately, bitterly and almost silently to the last man. Where the road disappears under a long canopy of trees, the men of the Resistance ambushed and destroyed a large convoy, and in doing so scored their first great victory. By the ruined wireless station where the road forks sharply, my Jeep "Cantharides" skidded and overturned and Chad and I were the only two who survived. Chad was the driver, and had missed death narrowly so many times that we often wondered for what great future he was destined. Shortly before I left England I heard that chance had wisely seen fit to preserve him for his present rôle—an anonymous but highly esteemed donor in an Artificial Insemination Clinic.

In his usual fashion Cæsar hung resolutely over the steering wheel as if the process of driving was a momentous test of supremacy between himself, time, distance and the machine. He had in no way changed from the days when he had been Chief Civilian Driver, H.Q. British Force Merveil. Notwithstanding his insoluble link with the dramatic heroism of the Liberation, in the years before the deluge, as a shrewd blackmailer, an agent-provocateur, and a trafficker in drugs, contraband and women, he had enjoyed a well-merited notoriety in the waterside dives of Marseilles, Toulon, Trieste and Genoa.

When the Germans rolled threateningly over the South, Cæsar sublimated his anti-social instincts and became a militant patriot. He attached to himself as comrades and bodyguards Zilli, a phlegmatic, stocky little shipping clerk

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from Marseilles, and Nikolai, a charming, unscrupulous and dangerous gigolo from Monaco. Together they fought a relentless, private war against the invader with the declared object of eliminating the Boche, anywhere and in any quantity. They bludgeoned and garrotted, stabbed and pistolled and created for themselves, particularly amongst the Gestapo for whom they had a morbid preference, a legend of terror. The ordinary people of the region loved them, the partisan groups grudgingly admired them, and the British agents who had been parachuted in to organize resistance detested them as highly irregular and politically dangerous meddlers. Once they ambushed the German Town Commandant, slit his throat and left him to dangle like a slaughtered pig from a post in the main square. The reprisals were horrible, and it was eventually felt by everybody concerned that the original gesture, although impressive, was somewhat lacking in good taste. Cæsar, however, was not often guilty of this type of tactical blunder. Mainly concerned, after national honour had been satisfied, with the economics of guerrilla warfare, he, his followers and dependants lived on the plundered fat of the German Army.

After peace came to Merveil, Zilli went back well satisfied to the capacious bosom of his Provençal family, Nikolai profited by the gullibilities of the G.I.s, and Cæsar was faced with the responsibilities of being a hero. The children called him respectfully "Cæsar the Great," and the police obligingly tore up his dossier. For a long time he considered the financial possibilities of honesty, and finally decided that he could make it pay. Accordingly he persuaded, with certain unanswerable arguments, an ex-collaborator to part for a nominal sum with the contents of his garage. Then with admirable foresight he hired himself and his Renaults to the British and became Civilian Transport Section, Force H.Q. Merveil.

The final incursion of Cæsar into an almost legitimate business coincided with the formation of British Forces in Merveil. When the Allies took a sudden but effective snap at this succulent portion of the soft underside of Europe, the British Element, like a poor relation straggled hesitantly and modestly along. As the establishment of G.I. clubs, P.X. canteens, and the triumphant blare of boogie-woogie consolidated the forward onslaught of the forces of liberation, the British, consisting mainly of technical and supply personnel, lagged farther and farther behind. Finally they withdrew to the coast and there entrenching themselves as an independent unit in the pre-war health resort of Merveil became officially known, for want of a better name, as British Forces Merveil.

Between the Army and Merveil it was love at first sight. And there was every reason why it should have been, for Merveil had a long and well-founded pro-British tradition. Victoria, as a young Queen and radiant wife, had spent an idyllic holiday on one of its loveliest hillside estates. A statue of Edward VII smiled good-humouredly across the Place to the Mairie, and the Hotel Grande-Bretagne and the Café de l'Entente Cordiale jostled each other for pride of place on the splendid Boulevard of Victory. Not even the intensive efforts of the Herrenvolk had succeeded in eradicating the evidences of this partisanship,

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and therefore when the British troops appeared as liberators, if only by proxy, they were welcomed with open arms as old and valued friends. Merveil itself was an aggregation of natural beauty. White villas, green-shuttered and red-roofed, clung haphazardly in a series of crazy terraces to the wooded slopes of the mountains, and meandered down by the sides of twisting dusty roads to silvery, pine-fringed beaches. There were palms and eucalyptus trees, oranges and scarlet oleander blossoms, the sun, the sand and the sea, and pervading everything the warmth which, with its narcotic quality of tropical langour, dulled and softened the irritations of war.

As the fighting died away to the north the prestige and authority of the Merveil sub-area grew steadily in importance. The senior officer, a staff-captain, became a major, and the major became a colonel, and the colonel one day dying in a surfeit of ecstasy he was replaced by a G.O.C., and Merveil had definitely arrived on the military map. Staff officers clustered and cackled and pecked inquisitively at juicy appointments, for the star of Merveil was rising and careerists were rampant. For those who were already in possession it was a time of rapid and worrying expansion. Standing on a hill behind the town was the magnificent Hotel de la Mediterranee, which, in the days of the Occupation had been a rest-home and convalescent depot for the "little grey mice" of the Nazi Women's Army. This was taken over as the headquarters of the administration and the billets of the garrison, and being a hygienist's paradise was for ever after quoted with pride in sanitary diaries.

The Officers' Mess, following the example of the defunct German C.-in-C. was sited after a careful search for booby-traps in the mediæval Chateau Merveil which crouched dark and forbiddingly on the crest of the mountain. It was spacious and damp and its walls were cemented with the stuff of history. Its absent owner was an international armaments king, addicted to patriotic speeches and fetishism, both pursuits, he was wont to claim, appearing to be good for business. It was soon after his most stirring appeal to his countrymen not to yield another square inch of territory to the enemy that the S.S. Divisions swept down to the Mediterranean, and he, in order not to embarrass his influential friends in both camps flew under diplomatic protection to his luxurious hacienda in South America. It was from there that he intimated through his contacts in the Nazi High Command that neither his castle nor its treasures were to be damaged by the peculiar accidents of war. He left behind him as his chatelaine an ennobled and half-witted kinswoman who, fluttering and twittering in the sombre library where she was perpetually dusting the backs of the leather-bound volumes which were stacked in piles reaching from floor to ceiling, reminded us continually that the Germans had always been "very correct." I was never very comfortable in that billet. The vaulted ceilings were too high, the corridors were too long, and too many ghosts from the past whispered in the dark corners of the stone stairways and empty boudoirs. Perhaps I was glad when the advent of a new Commander changed the tenor of our lives. This General, apart from appointing himself the paramount and final authority on all matters medical, was content to

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leave us to our own devices. With a small entourage he moved from the castle to a huge and ornate villa by the sea.

Relieved of the tedium of constant formality and supervision we too quitted the chateau. Setting up individual messes in the pleasant comfortable little villas that dotted the wooded hillside we allowed the summer months to pass tranquilly by. The men were fit, happy and deeply bronzed by the sun, and words such as " Repat." and " Demob." began, even when they did occur in conversation, to carry less and less conviction until finally they completely disappeared. Sick parades were minute in size, and the magnificently equipped hospital on the seashore, empty and avid for patients, served merely as an advanced base for beach parties and afternoon regattas.

Although it seemed that we were living in an Arcadian isolation detached from the realities of war, it was constantly stated that we were fulfilling from a military point of view a very necessary and arduous function. On that happy basis of mutual understanding we were quite prepared to rest. Moreover, in addition to all the official festivities which marked the milestones on the road to a complete and overwhelming victory, we had our domestic excitements. One day, the Intelligence Officer, living surprisingly for once up to his name, announced with some self-satisfaction his engagement to a young and vivacious war-widow who, besides being endowed plentifully with many physical attributes, was the sole heiress to the richest and largest estate in the province. This was the first liaison to be recognized and blessed by authority, and both we and the civilians saw in this an appropriate symbol of understanding between two ancient allies. On the day of the marriage the whole town was *en fête*, and they danced in the streets and drank in the houses till the dawn light breaking over the roof tops found even the national flags of the two countries intertwined in a libidinous embrace. When the Senior Supply Officer, a highly choleric and unpopular individual, was afflicted at the height of an alcoholic argument, which he had provoked,with a mild apoplexy it was felt by everyone that the occasion had been an unqualified, even though wearing. success.

The musical comedy atmosphere of our peaceful occupation was not always apparent. Occasionaly one had a glimpse of the bitterness and impartial cruelty which inevitably mark the aftermath of an international catastrophe. There were the days when the menfolk of Merveil trickled back from forced labour battalions and concentration camps. Changed by privation, prematurely aged and strangely silent, they came back to find, in many cases, that there was a gap of experience between themselves and their families that could never be bridged. But they were never as vociferous in their indignation against the Germans as the local Committee of Patriots who, engaged in a perpetual witch-hunt, sought to uncover and humiliate those who had dared to collaborate in any way with the enemy. The term " collaboration " was relative, for every inhabitant of the town in order merely to exist had been forced to come to some sort of terms with the conquerors. Ironically enough it was noticeable that just as after the Liberation there appeared a sudden crop of quasi-leaders of the Resistance who had never resisted, so the most

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self-righteous members of the Committee of Patriots were those who had gleaned most profit from the Occupation and whose personal conduct had been anything but above reproach. The greatest zeal was expended in punishing those women who had fraternized with the Germans and the Italians, and the simple method of denunciation to the Committee became a much-abused weapon of personal vengeance in the matter of old jealousies and feminine feuds.

In one of its rare excesses of communal sadism the mob, inspired by a rejected and mentally warped suitor, dragged from her house Suzanne, who was known to many of us as a charming, intelligent and beautiful girl, the only surviving child of a very brave soldier who had died in his country's defence. She was accused of entertaining alone and at night an Italian officer. She could have told them the truth, that in fact he was a distant kinsman who had paid her a short formal visit and had left after a cold exchange of courtesies. But she, in the manner of her kind, disdained to give any explanation, and remained completely unmoved until they tore the dress from her shoulders and began to crop her golden hair close to her skull. And then she began to sob and moan in an intensity of shame and anguish which would have moved any but a crowd besotted with its own sense of worthlessness and guilt. The few British soldiers who were passing rushed to help her and ignoring the imprecations of the rabble removed her to the security of the Military Hospital. It says much for her courage that as soon as she was able she went back to the town and with a cool detachment carried on as if nothing had ever happened to disturb the unexciting routine of her ways.

But of course all these things that happened were the fault of Merveil itself. There was something in its sensuous hot-house atmosphere which made a grotesque caricature of people's personalities. Having a communal barrack life with its real material earthiness to keep them sane the other ranks were not nearly so affected as the officers. One young subaltern wrote passionate sonnets in ancient Greek and presented them to mystified and disappointed country girls. Another would spend hours relating with psychopathic charm and an air of conviction the most improbable and fantastic stories of his experiences with the European underground. One major, a rugger International in his prime, collected dungeons. Carefully tracking down some ancient prison or keep he would sit patiently in a dank cell alone and in the dark, and afterwards write copious notes on his vintage detentions. If the mood took him he would have himself chained to rings in the wall, and being fed with bread and water would pass with equanimity a quiet and solitary week-end. In our own Mess a certain taciturn gentleman would spend all his leisure locked in his room where behind shuttered windows and oblivious of the warm sunlight he would hammer and hammer away at some mysterious and unending project. No one was immune from these idiosyncrasies, for in the fertile soil of Merveil eccentricities germinated and grew. The district was a psychiatrist's happy hunting ground, and even those who retained some vestiges of insight would sometimes peer with trepidation into their shaving mirrors in the morning half-expecting to see the beginnings of a sort of Jekyll and Hyde transformation.

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Enemy capitulations followed each other in rapid succession and soon we settled down in an uneasy armistice to receive the blessings of peace. Not the least among these was the fact that for the first time Service families were to be allowed to be reunited on foreign soil. Innumerable conferences were held, and with a flourish of welfare trumpets the first wives and children arrived. Beside the radiant, golden-brown Amazons of the South the women looked a little shabby, strained and tired. This perhaps accounted for part of their initial unfavourable reaction to Merveil. It was a sentiment with which we could sympathize and understand. They resented above all the fact that whilst in England there had been endless queues, short rations, buzz-bombs and worrying children, here in this military backwater their men-folk had lived securely in an abundance of warmth and exotic splendour. Many husbands who had temporarily shelved their obligations were awakened with a rude shock from their Mediterranean enchantment. When the wives had adapted themselves to the new sensation of comparative luxury and the ego-satisfying status of victors in a less fortunate country they began to find that time hung unexpectedly heavy on their hands. So they began to bicker, at first individually and later collectively, occasionally on matters of importance but more often about trifles. The repercussions inevitably affected the husbands. Where once in the Messes there had been camaraderie and a measure of good-natured tolerance there was now a communal despondency and a perpetual sense of irritation. The old masculine *bonhomie* was fast disappearing, but I was spared the sight of the final desecration of our erstwhile Eden by being posted to the North.

It was on all these things and a million others more pleasant that I reflected as the car rattled over the level-crossing and turned down the gentle slope in to the centre of Merveil. The town dozed on in a dreamy somnolence. The location signs were missing, but apart from that very little had changed. The Transit Officers' Club, bearing no scars of its once nightly ordeals, still stood in dignified isolation at the corner of the square. Where the Y.M.C.A. had offered buns and entertainment there was now a gaudy, chromium-plated cafe. There were even a few old Army trucks, unsuccessfully disguised, standing forlornly in shady back alleys and possibly regretting in their stolid, mechanical ways the days when they had been fairly reasonably maintained.

"Ah—yes," said Cæsar, breaking in with an embarrassing clairvoyance on my train of thought, " those were the days—there was always something to look forward to. Now what have we got! Peace? Some peace! We've got a Black Market—the best in the world, and we've got the Communists. And to fight the Communists we've got to rely on the others. Up there in the North the Boche is laughing at us. I tell you, my old friend, like you British with your pitiful few pounds, we're between the Devil and the deep blue sea."

He turned one palm outwards, shrugged his shoulders, and gave a wry smile.

"Who would ever have thought that we would look back to those days with even the smallest bit of regret? Do you remember the night I took you and the fair-haired young captain over in your boat to the islands?"

"No," I said.

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"But, monsieur, you must remember!" gasped Cæsar, his blue jowls becoming slack in incredulous astonishment.

"No," I stated with firmness and finality, "I don't remember. And what is more, you are probably mixing me up with somebody else. And even if it did happen, it most likely happened before or after my time."

It was really a stupid denial because I could never forget either that one or any other single incident of those eventful days. You closed your eyes in a flat in London and once again you saw the torchlight gleaming on the bayonets in the Victory Parade, the trail of the moon across the phosphorescent water, and heard in imagination the nocturnal symphony of frogs and nightingales. But my wife, who understands and speaks the language better than I do, was listening much too intently, and I decided that it were better for the futures of all of us if those recollections remained undisturbed in the unofficial war diaries of H.Q. British Forces in Merveil.

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WHAT EVERY MEDICAL OFFICER SHOULD KNOW ABOUT THE ATOMIC BOMB

The ninth and tenth of a series prepared by the Special Projects Division, Office of The Surgeon General

IX. Essentials of Instrumentation

THE detection and measurement of high energy radiation depends on the proper use of suitably constructed instruments, since nature has not seen fit to provide man with senses capable of responding to it. Without instruments even intense radiation fields will not be recognized until irreparable damage has been done. If photographic film and a few special methods are excepted, all detecting devices are based on the ionization produced in gases by the incident radiation. When an ionizing agent enters a gas, it may act on a neutral atom or molecule with a force large enough to remove one or more electrons from the atom. It is most probable that two ions will be formed, and so it is customary to speak of the formation of *ion pairs*. The average energy loss per ion pair in air is about 33 electron volts.

If ions are formed in a gas subject to an electric field, they will move in opposite directions—the negative ions toward the positively charged anode and the positive ions toward the negatively charged cathode. The current flow will be extremely small, and special measuring devices are required to detect it. Because of the neutral attraction of oppositely charged particles, there is always a tendency for ions to recombine and form neutral atoms. The chance of recombination is greater the longer the time before the ions reach the electrodes. The fraction lost decreases with increasing voltage, and eventually all of the ions are collected so that there is no further increase in current. This condition is known as saturation and the maximum current is called the *saturation current*.

Instruments for measuring the amount of electric charge collected in an ionization chamber are known as electroscopes and electrometers. The *Lauritsen electroscope* is one of the most generally useful instruments for radiation measurements. The moving system is a quartz fiber about 5 microns in diameter, made capable of conducting with a thin metal coating and cemented to one arm of an L. Mutual repulsion causes the quartz fiber to deflect. Ions formed inside the case will neutralize the charge and the fiber will return toward its uncharged position. Another useful quartz fiber instrument is the pencil type electroscope, or *dosimeter*. This is essentially a Lauritsen electroscope modified so that the entire instrument is about the size of a large fountain pen. Instruments of this type are very useful for measuring integrated exposures. They can be made with a sensitivity such that 0.1 r. will produce about one-half of full scale deflection.

Ionization chamber instruments vary widely depending on the particular type of radiation to be detected. Short range radiation is admitted to the chamber through a suitable window. A thin mica or stretched nylon film about

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0.0001 in. thick is satisfactory for alpha particles. If beta particles are to be measured, the windows need not be so thin. When a photon enters the ion chamber and is absorbed, high speed electrons are produced that travel through the gas in the chamber, producing ions until their kinetic energy is spent For 0.2 Mev x-rays this requires a chamber about 20 cm. in diameter.

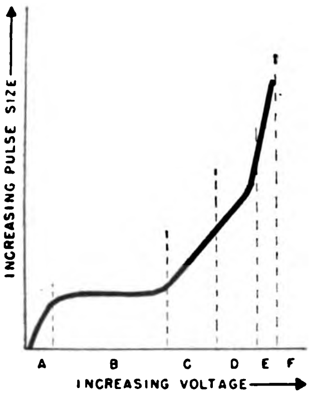

FIGURE 1. Ion chamber pulse size versus voltage.

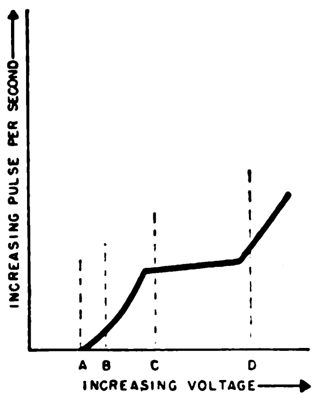

FIGURE 2. G-M tube characteristic.

If the voltage is raised still further, the gas amplification factor will continue to increase, but in region D (figure 1) the amplified pulses are no longer proportional to the number of primary ions. A sort of saturation effect begins to enter at this point, and, consequently, a few primary ions will produce nearly as many total ions as are obtained from a large number of primary ions. There is still some difference in final pulse sizes, however, so this region is known as the region of limited proportionality. The gas amplification continues to increase with further increases in voltage, and region D gradually changes to region E where all proportionality ceases. Here a single ion pair is sufficient to produce an amplified pulse of the same size as that obtained from a large number of primary ions. This is known as the *Geiger region* and is characterized by gas amplification factors of the order of 10^8. This is the portion of the tube characteristic commonly used for counting beta and gamma radiation. The Geiger region usually extends over a range of about 200 volts. When still higher voltages are used, the region of *continuous discharge*, F, is reached. In this region the tube is too unstable for useful operation, and care must always be taken to keep the tube voltages below the continuous discharge value. Actually the tube does not go into continuous discharge, but, rather, produces a series of closely spaced pulses from one initial ionizing event.

A second type of characteristic curve is helpful in understanding the operation in the Geiger region. Assume the tube to be exposed to a constant radiation intensity, but with the incident particles or photons having unequal energies. Pulses per second when plotted against the applied voltage yield a curve similar to figure 2. The associated electronic equipment for recording the number of pulses will not respond to the small pulses produced in the ionization chamber

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region where there is no gas amplification. Consequently, the curve will have a threshold, A, below which no pulses will be recorded. As the voltage is raised and the gas amplification becomes appreciable, the most energetic particles will be counted, but the weak ones will be lost. This is the region of proportional counting, AB. As the gas amplification continues to increase with voltage, more of the less energetic particles will be counted until point C is reached. Point C is the threshold of the Geiger region, CD, and here practically every particle entering the tube is counted. Point D is the threshold of the continuous discharge region.

Assume such a counter exposed to a constant amount of radiation, each ionizing particle or photon having the same energy. Each ionizing particle entering the chamber will produce a definite number of ion pairs in the gas, and these ions will proceed to the collecting electrodes where they will be neutralized and will produce a pulse of current in the external circuit. If, now, the size of the pulse is plotted against the voltage applied to the electrodes, a curve similar to that of figure 1 will be obtained. Regions A and B represent the normal ionization chamber working conditions where the only ions contributing to the pulse are those produced by the original radiation. Over region C there is some gas amplification occurring very close to the central wire. In this region the gaseous amplification is quite stable for any given voltage and does not depend on the number of initial ions present. Thus, if the voltage is adjusted to a value such that the gas amplification factor is 1,000 and an incident beta particle produces 100 ion pairs, the pulse received at the electrode will be 10^5 ions. Under the same voltage conditions an alpha particle producing 10^5 primary ion pairs will yield a pulse of $10^5 \times 10^3$, or 10^8 ions. Because of the rather strict proportionality between the amounts of initial and total ionization, this portion of the curve is known as the *region of proportionality*, and a counting tube operating in this region is called a *proportional counter*. A proportional counter can be used to measure alpha particles or neutrons in the presence of strong beta and gamma radiation.

A small portable chamber should have the same absorption for x- and gamma rays as the air in the standard chamber and should also have the equivalent of the long air paths for the absorption of the high energy electrons. Chamber walls are regularly made of bakelite or plastics, both containing a high percent of carbon atoms. Since human tissue is composed chiefly of carbon, oxygen, nitrogen, and hydrogen, such an instrument will simulate absorption by the body. Ionization chambers designed on these considerations are known as *thimble chambers*. One successful thimble chamber instrument that is not entirely satisfactory for survey purposes is the *condenser gamma meter*. The chambers must be charged, left in the radiation field for an appropriate time, and then read with the meter. If a large contaminated area were to be surveyed, an enormous number of such chambers would be required. Such an area would require an instrument that would give a steady deflection proportional to the amount of radiation striking the chamber. Unfortunately, ionization currents are too small to be measured with portable meters, and it is necessary to use

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other means. It is perfectly feasible to measure currents of this order with suitable vacuum tube circuits.

Geiger-Müller (G-M) counters take advantage of the gas amplification that can be obtained when high accelerating voltages are applied to an ionization chamber. When an ion has an energy greater than the ionization energy of the gas molecule, it may produce secondary ions on collision. The secondary ions formed will in turn be accelerated by the electric field and may produce further ionization. This cumulative effect is known as *avalanche ionization.* If a total of A ion pairs results from one original pair, the process is said to have a gas amplification factor of A. In practice, A varies from about 10 in gas-filled photoelectric cells to 10^8 in some G-M counters. At a pressure of 10 cm. of mercury, gas amplification can be obtained at voltages of 250 to 1,500 volts depending on the gas and the tube dimensions. G-M counters usually have a cylindric cathode 1 to 10 cm. in diameter with a length 2 to 10 times the diameter. The anode consists typically of an insulated axial wire 0.001 to 0.005 in. in diameter.

The Geiger region is known as the *plateau*, and it is obviously desirable for a tube to have a long, flat plateau, since here the counting rate does not depend strongly on the applied voltage. To obtain desirable plateau characteristics the filling gas and pressure must be carefully chosen, and the central wire must be free from dust, sharp points, or die marks. Oxygen and water vapor are particularly undesirable and must be completely removed before filling. Argon is a very satisfactory gas and is used in practically all counters. Near the central wire a large number of electrons and positive ions will be formed in the avalanche. The electrons have a small mass and are already close to the central wire, so they will move toward it with high velocities and will be completely collected by the wire in 10^{-6} sec. or less. The positive ions, on the other hand, have to travel out to the negatively charged cylinder. Since they have comparatively large masses, they move much more slowly than the electrons. The positive ion cloud will reach the cylinder in about 10^{-3} sec.—long after the electrons have been collected at the wire. As a positive ion approaches very close to the cylinder, it will pull an electron from the cylinder and become a neutral molecule. In general, the electron will go into one of the upper energy levels so that the molecule, although neutral, will be in an excited state. The molecule will, however, promptly return to the ground state and in so doing will radiate a characteristic series of spectral lines. Some of these lines will be in the ultraviolet region of the spectrum and, consequently, will have sufficient energy to liberate photoelectrons from the metal cylinder. With high tube voltages a single photoelectron will be sufficient to start a second avalanche, and thus the entire process will be repeated over and over again.

It is possible, however, to construct counters in which the discharge can be stopped. These are known as *self-quenching* or fast counters. A self-quenching counter can be produced by adding to the usual filling gas a small amount of a polyatomic vapor, such as alcohol or xylene. These complex molecules strongly absorb ultraviolet light, and by this mechanism the photoelectric omission at the cathode is prevented. Most of the polyatomic molecules introduced to make

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self-quenching counters are vapors at room temperature, and these counters are likely to show a sensitivity that changes with temperature. A further disadvantage lies in the fact that some of the quenching gas is dissociated at each discharge, and so these counters have a limited life. A very satisfactory self-quenching counter can be made by filling the tube with 10 percent alcohol and 90 percent argon to a total pressure of 10 cm. of mercury. With a non-self-quenching tube, an auxiliary circuit must be used to stop the discharge.

Any counter will give counts when placed in a neutron field, but better results can be obtained with specially designed tubes. To detect slow neutrons, the counter is filled with boron trifluoride, which is a gas at room temperature. A slow neutron may produce a nuclear reaction with the boron. This reaction liberates a considerable amount of energy, and the alpha particle and the recoiling lithium will have sufficient kinetic energy to produce heavy ionization that will trip the counter. By using the counter in the proportional range, it is possible to obtain a count for each disintegration even in the presence of large beta and gamma intensities. The capture probability decreases with the neutron velocity, so the reaction is not efficient for fast neutrons. Fast neutrons may be detected through the recoil atoms they produce when they collide with the gas atoms in the counter. The recoil atoms produce intense ionization, and hence, if the counter is adjusted to the proportional range, the counter will discriminate against beta and gamma radiation. Fast neutron counters have a rather low efficiency because of the low cross section for the collision process. Neutron counting is complicated by the change in behavior with velocity, and the present neutron counters are far from satisfactory.

None of these devices gives an absolute measure of radiation intensities. It is, therefore, necessary to calibrate them in terms of known standards. This is not difficult if a gamma ray calibration is required in terms of roentgens. It has been established by careful measurements that 1 mg. of radium, in equilibrium with its products and inclosed in 0.5 mm. of platinum or its equivalent, will produce an intensity of 8.4 r. per hour at a distance of 1 cm. The inverse square law can be used to calculate the intensities at other distances. Standard x-ray sources, properly aged and carefully calibrated, are available from the National Bureau of Standards. Calibration of x-ray measuring instruments should be accomplished against primary standard ionization chambers or carefully calibrated secondary standards by a well-equipped laboratory such as the National Bureau of Standards or by a reliable instrument manufacturer.

TABLE I

Emulsion	Useful sensitivity range (roentgens)	Emulsion	Useful sensitivity range (roentgens)
Type K	0.05– 2.0	Kodalith 6567 ..	70– 700
Type A	1.0 – 10	Kodabromide G–3 ..	400– 8,000
Cine positive 5301 ..	5 – 80	548–0, double coat ..	2,000–10,000
Cine positive fine grain 5302	40 –400	548–0, single coat ..	5,000–20,000

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In making alpha and beta particle measurements quite different considerations enter. Radioactive materials emit particles in all directions with equal probability, and, in general, a chamber or G-M tube will intercept only a fraction of the total emission. For example, if the active material is spread in a thin layer on the bottom of the chamber, only one-half of the ejected particles will reach the gas and produce ionization. It is then necessary to calibrate the chamber in terms of a known radioactive material. Various members of the naturally radioactive series are useful for this purpose. Photographic materials are also important tools for the measurement of radiation, since high speed particles and high energy photons produce developable images. Although photographic films and papers lack the accuracy attainable in the laboratory by electrical methods, they still play an important role in radiation measurements. A film is one of the simplest detectors of radiation, is small and light, can be obtained with a wide range of sensitivity, provides a permanent record of exposure, and has no complicated electronic circuits to get out of adjustment. For many applications these facts more than outweigh the disadvantages of film processing, the time required to obtain a measurement, and the variations inherent in photographic materials. Table I lists a series of emulsions that have proved useful for measuring beta and gamma radiation. It can be seen that a single emulsion will cover an exposure range of about 1 to 10.

Photographic film meters are usually made into packets of dental film size (1.25 by 1.75 in.) and covered with an opaque wrapping to protect the film from visible light. Any combination of suitable emulsions can be put into a single packet. A cross of thin sheet lead about 1 mm. thick is attached to the packet. This absorber is sufficient to stop all beta particles so any darkening under the cross will be due to gamma rays. The cross also serves to enhance this darkening because of the larger number of electrons ejected from the lead. The regular wrapping is sufficiently thin to permit the penetration of all but low energy beta particles. Thus the film can be used to measure both beta and gamma exposures. In general, film processing is conducted in accordance with the manufacturers' recommendations, but variations may be used. Whatever procedure is used, it is most important to control time and temperature as accurately as possible. The developer should be in a tank surrounded by a constant temperature bath, and the films agitated throughout development. The importance of time and temperature control, scrupulous darkroom technique, and the use of fresh chemicals cannot be overemphasized.

Special emulsions are now available that are almost insensitive to visible light, and beta and gamma radiations, but will respond to heavy particles such as protons, deuterons, or alpha particles. These particles have such a low penetrating power that the emitting substance must be placed in direct contact with the emulsion. These emulsions are not used for personnel monitoring, but rather to detect alpha particle contamination. These emulsions will detect alpha particles in the presence of strong beta and gamma radiation, and under conditions that make the operation of electrical alpha particle detectors uncertain if not impossible. With weak exposures the plate will not be uniformly darkened and individual alpha particle tracks can be seen by

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using a microscope. Since alpha particles are emitted with an energy characteristic of the emitting nucleus, the track lengths may frequently be used to identify the alpha emitter. The various film emulsions can be used to make radio autographs of specimens containing radioactive materials. By exposing sections of the specimen it is possible to determine the cross-sectional distribution as well. The resolving power of photographic emulsions for determining the precise position is limited, and it is scarcely possible to determine the location of radioactivity to less than 1/100 mm.

X. Protection Against Atomic Bombs

PROTECTION against atomic bombs may be divided into passive defense and active defense. The important effects of the atomic bomb against which protection must be developed are: (1) the blast or shock wave; (2) visible light, ultraviolet, and infrared radiations; (3) nuclear radiation; and (4) psychological effects.

PASSIVE DEFENSE AND PROTECTION

Blast.—The effects of the atomic bomb rapidly decrease in intensity as one moves away from the point of detonation; thus, distance is always the best protection. Primary shock, or blast damage, is defined as the compressive and tearing action of the shock wave on the human body. When one interposes between the blast and the body an object of strength similar to that of an ordinary wall, this form of damage is effectively reduced. Primary shock is thus of importance only when a person is in the open, in which case he is exposed simultaneously to lethal amounts of other effects of the atomic bomb. Living things are remarkably resistant to blast damage and are much stronger in this respect than normal buildings. Underground shelters and normal reinforced concrete buildings protect against this effect very close to the point of detonation. Petechial hemorrhages of the lung occur from blast damage in its mildest forms. In its severest forms major abdominal hemorrhages appear.

Secondary shock, or blast damage, is caused by flying objects hitting and lacerating the body. A shock wave is very much like a wind of several hundred miles per hour, arising instantaneously, and lasting for about a second. This wind is strong enough to throw the body several feet. It also breaks windows, knocks down plaster, and throws other objects around with great violence. When these objects strike a person secondary shock damage results. There are many things a person can do for himself to reduce his chances of this type of injury if he has some advance warning of the detonation. He should keep away from windows and lie flat on the floor or ground. He should avoid standing under overhanging cornices, chimneys, and other heavy objects that are easily knocked down. Underground installations or shelters greatly reduce this effect, because very little of the air shock is transmitted through the ground and thence into shelters or basements. In Japan, this form of injury combined with burns accounted for most of the casualties. The rapid follow-up of the fire on the blast damage caused many deaths among the injured. Injuries of this type require evacuation and hospitalization. In the cases of primary shock

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damage there is an amazingly small boundary zone. One is either killed immediately or is all right after a few minutes, so far as this effect is concerned. There is much that can be done in the design of vital installations to reduce damage from these secondary shock effects.

Flash burns are injuries created by direct exposure to the visible and near-visible radiation emanating from the point of detonation. The thinnest type of nontransparent material will shield effectively from this effect. Light-colored clothing is particularly good as it reflects almost all this radiation. Dark clothing will not transmit this radiation but will catch fire and produce flame burns on the skin beneath the clothing. This form of damage is important only when a person is in the open and in direct line of sight with the point of detonation. Because of the nature of the atomic bomb, this form of damage occurs at greater distances than those caused by any other effect.

Flame burns are produced by fires started in inflammable materials or buildings. These were prevalent in Japan, but they would occur to a lesser degree in an American city. This possibility of fire and subsequent injury can be greatly reduced by making structures less inflammable. The development of large quantities of adequate fire-fighting equipment and trained personnel can furnish great protection. To reduce this form of damage it will be necessary to have fire-fighting equipment and personnel so located that a major proportion will not be wiped out by the detonation. Accounts from Hiroshima and Nagasaki point out the inadequacy of Japanese fire-fighting equipment and procedures. In both cities, about 90 percent of the equipment and personnel for these duties were wiped out immediately. Major efforts should be directed to reducing the possibility of flame burns, not only because they produce a large number of casualties, but also because these casualties need so many trained persons and so much equipment for treatment and hospitalization.

Nuclear radiation. The use of nuclear radiation in warfare presents new problems for both the military and the civil population. These effects are not only important but complex, as they may be caused by external and internal radiations and may be immediate or delayed. For all nuclear radiation effects, distance is by far the best protection. Immediate radiation effects are produced in a matter of a few thousandths of a second after detonation. With the atomic bomb, about 99 percent of the nuclear radiation produced comes out in the first fraction of a second after the detonation. It consists of penetrating radiations that come from outside the body and therefore constitute an external hazard.

Large quantities of gamma rays are produced almost immediately by the detonation and radiate in all directions. These rays travel in a straight line as does light. They are highly penetrating, and it takes a large amount of material to absorb and stop them. It is important to realize the directional and shadow producing characteristics of this radiation. One does not need shielding on all sides but merely on the side of the detonation. In shielding against gamma radiation the important thing is the weight of the material that is between the body and the source. The chemical characteristics of the shield are of no importance. Lead is often used in laboratories where gamma radiation or

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x-radiation occurs. This is a suitable substance because it occupies a very small volume in comparison to its weight. The effectiveness of a shield is most often described by means of thickness of the material that is necessary to reduce the intensity to half the initial amount. This is called the half-thickness of that material. The approximate half-thickness of common construction materials are 1 in. for steel, 3 in. for concrete, and 4 in. for wood or earth.

Neutrons also constitute an external hazard at the time of the detonation. They are not as effective at great distances as the gamma rays, but they require consideration because, being uncharged particles, they are difficult to stop and shield against. Shielding is not as simple as in the case of gamma radiation, because the weight of the shielding material is not the important factor. Instead, the important characteristic is the ability of the particular element or compound to slow down and then capture neutrons. The neutrons that occur in the detonation of an atomic bomb are essentially fast neutrons. Substances such as cadmium and boron capture slow neutrons to an amazing degree; but, since these neutrons are not slow, these substances are of little value in defense against the atomic bomb. The best substances are those with low atomic weights. Hydrogen, the lightest of all substances, is the best; hence, in shielding against neutrons, the best substances for their weight are those containing large amounts of hydrogen, such as water or paraffin. The approximate half-thicknesses of common materials are between 3 in. and 12 in. for steel and about 6 in. for concrete, earth, wood and water. Since neutrons, like gamma rays, travel in a straight line from the point of detonation, radiating in all directions, the shielding need be only between the person and the source.

Delayed radiation. About 1 percent of the nuclear radiation produced by an atomic bomb is not produced immediately but, comes from the decay of the fission products. In an air burst, where the fireball and mushroom cloud containing the fission products go up in the air to be dispersed by the wind, this delayed radiation is negligible. In an underwater burst, or possibly a surface land burst, a base surge will probably occur. This cloud, moving close to the ground, contains a large proportion of the fission products. As this cloud sweeps out over ships or cities, it surrounds buildings, people, and equipment. The radiating material is then extremely close to a person. The relatively small amount of radiation that is left after the detonation is greatly enhanced because of its proximity. This base surge, in comparison to the mushroom cloud after the air burst, produces radiation intensities on the ground that are higher by many thousandfold. This is due solely to the fact that the base surge can surround individuals on the ground. When it is realized that at Bikini this base surge moved over an area of about 5 sq. mi., this is seen to be a very real hazard. It takes time for this cloud to move, and, as the radiation from it is only of importance when it surrounds the point in consideration, there is available a varying amount of time in which to get out of the way or to dodge the cloud. This base surge moves with varying speeds. Initially it spreads out at about 50 m.p.h. Its speed constantly decreases until it is dispelled. For this cloud to spread over its maximum area requires several minutes. If one is in a city, great protection will be afforded if one gets down into a basement or

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sub-basement, or into an air-raid shelter. It is of importance also to note that this radiation from the base surge is nondirectional, as it comes from all points in the cloud. Hence, any shield that is devised must be on all sides, including the top, of the location considered.

Delayed gamma radiation from the base surge is similar to immediate gamma radiation, except in its nondirectional characteristics. The shielding requirements are similar to those in the previous situation, in that the same half-thicknesses are applicable. There are no delayed neutrons of significance; hence, special shielding is of no importance in this problem. In the delayed situation we also have important beta radiation. Immediate beta radiation occurs but does not travel a very great distance from the source, because of the efficient shielding furnished by air. Where the base surge is surrounding the location in question, beta radiation is important, because the half-thickness of air is about 4 yd. Normal clothing furnishes sufficient shielding to beta radiation. Similarly, thin walls and the glass in windows are adequate. It is, of course, nondirectional and comes from all sides. The extent of the external hazard furnished by beta radiation is not well understood. It is believed comparable to that of gamma radiation when a base surge has been created. Alpha radiation occurs from the nonfissioned plutonium and uranium. This radiation constitutes no external hazard, as the skin furnishes adequate shielding. All the alpha rays are absorbed in the epidermis with no resulting damage to living tissues.

Internal radiation gets into the body through inhalation, ingestion, or injection. This is a delayed hazard and is possible only where one is in the base surge, the mushroom cloud, or an area over which the base surge has previously passed. The internal hazard generally occurs only where there is also an external hazard. If one is exposed to the base surge or is in the mushroom cloud, the external radiation is often lethal without any consideration of an internal hazard. Particularly if one is working in a highly contaminated area after the detonation, there is a significant, but not necessarily lethal, degree of external hazard; but there is also a very great internal hazard. This is created by disturbing the dust and usually enters the body through inhalation. An additional hazard exists from eating with contaminated hands and thus getting the active material into the body through the mouth.

In the case of an atomic explosion, a small amount of this radioactive material is in the form of a true gas or vapor. Almost all of it exists on particles of dust or droplets of water. These contaminated particles have a size range of from 0.1 to 10 microns. The filter in a modern gas mask such as the assault mask is believed to give adequate protection. This filter is extremely efficient. It is quite possible that new masks will be devised that will protect against atomic, biologic, and chemical warfare. Such a development is highly desirable. Protective clothing would be required for workers entering contaminated areas. It would probably be permeable clothing. Its main requirement is that it should be disposable. Its functions would be to keep contaminated material from the skin and possible later entry into the body. Disposability is desirable, as these materials cannot be rendered harmless by any physical or chemical means.

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Collective protectors with filters or inclosed air-conditioning systems are probably indicated for vital installations and underground shelters in anticipation of atomic warfare. Such items would prevent the highly contaminated air of the base surge from entering installations that otherwise would furnish adequate protection against the effects of the atomic bomb. The development of decontamination techniques and facilities is indicated to reduce the long-term possibility of personnel becoming contaminated and later having active material enter the body through the respiratory and digestive tracts. Such techniques will probably consist of washing away, carrying away, or burying the active material.

Education. In an attack on a modern city it is believed that about 50,000 deaths would result from a single bomb. It is felt that, if the individual civilian and soldier in such a city were adequately trained as to what he could do for himself after the detonation occurs, perhaps 10,000 lives could be saved. The development of atomic defense for the individual will be the subject of much work in the future. The education of large numbers of persons, both civilian and military, for special jobs in atomic warfare is important, and will probably be given to such people as radiologic safety personnel, medical officers, civilian doctors, and civil defense technicians. The method by which the individual indoctrination and the specialized training is given will determine to a large extent the psychological preparation that will be attained in a population. It is highly desirable that we impart the proper degree of knowledge to all so that each individual has a respect for the special hazards of atomic warfare, thereby avoiding the undesirable extremes of excessive fear or ignorance. This will be a difficult job and the Nation is far from attaining this goal at present.

A large amount of detailed defense planning will be required for the protection of the Nation. It will include large-scale training of such specialists as fire fighters, evacuation control personnel, first-aid personnel, and decontamination groups. Large stock piles of food supplies, medical supplies, and disaster equipment will be required in relatively invulnerable locations. Preparations will be required for mutual aid between cities and major installations. All civil and military groups must be equipped and trained in the detection and isolation of contaminated areas. This new hazard created by nuclear radiation is the one hazard that may not be detected by any of the physical senses. It requires special instruments and special consideration. With sufficient indoctrination and a few minutes advance warning of an attack, it is quite possible that a 50 percent saving in casualties can be effected. This establishes the fact that development of advance detection techniques and warning signals is of the greatest importance to insure the continuation of our present existence.

Active Defense

Of less direct importance to the medical profession but of the utmost importance to the Nation is active defense, which means the prevention of an atomic attack. Regardless of our degree of preparation and protection, large numbers of casualties and a more important amount of disorganization and dislocation will occur. The attempts of the United Nations Organization to

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set up machinery to insure peace in the future, if successful, will be the greatest protection we can have against the atomic bomb. The basic responsibilities of military organizations require that they assume that war will occur.

Regardless of the political situation, the military organizations must constantly maintain the highest level of preparedness. In the case of atomic warfare this will consist of extensive stock-piling of all weapons, including atomic bombs. It will require readiness of retaliation forces. Because of the nature of the atomic bomb, it will require extensive protection of our ability to retaliate and conduct an offensive war. As was seen above, advance warning is most important—thus an efficient foreign intelligence corps is vital. Some persons have raised the provoking thought that, because of the capabilities of the atomic bomb, we shall lose an atomic war unless we attack first, assuming the enemy has atomic bombs.

A vital part of active defense that is erroneously played down in articles in the press is the assumed futility of interception of an atomic bomb carrier. Within the last few weeks our authorities on guided missiles have stated openly that it is their belief that guided missiles cannot be used to carry an atomic bomb for at least ten years. The military authorities must concentrate on the intervening years in which it is anticipated that a manned aircraft is the most likely vehicle. We have had only a fair degree of success in the interception of aircraft on bombing missions. There is no scientific reason why our degree of interception cannot be raised to nearly 100 percent if sufficient money, time, and technical ability are put on the problem. Atomic warfare presents a truly horrible outlook. It is our duty to push to the utmost any procedure that could possibly reduce its effectiveness against us.

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Clinical and Other Notes.

A CASE OF INFANTILE KALA-AZAR

BY

Captain M. G. PHILPOTT

Royal Army Medical Corps

THE opportunity to see the Mediterranean type of kala-azar, as it occurs in children, is rare in the United Kingdom. The following case, which was demonstrated at the Western Command Monthly Clinical Meeting held at Military Hospital, Chester, on June 9, 1948, seems worth while reporting.

S. W. (aged 7 years) was seen at the Medical Outpatient Department on May 26, 1948, and admitted the same day for investigation. She had been in good health until two months previously when she began to appear off-colour. She would not eat, was miserable and testy, seemed to have lost weight and complained of headaches.

The patient was born in Malta, of an English father and a Maltese mother. She had lived all her life in Malta and was still there at the onset of the symptoms. During April 1948 she was admitted to the Families Wing at the Military Hospital in Malta, where a clinical diagnosis of kala-azar was made. Her blood-count showed a leucopenia and there was some anæmia. Sternal puncture revealed no abnormality but no other investigations were made. On the diagnosis treatment was commenced with pentavalent antimonials and two injections had been given before she came to the United Kingdom in May.

Past Medical History.—A full-term baby. Birth-weight 8 lb. Normal infancy. Measles.

Family Medical History.—Mother and father alive and well. Two sisters alive and well. One sister alive with tuberculous hip disease.

Examination on Admission.—A tired pale child. Thin and looking rather ill. Weight, 48 lb. Mucous membranes pale. Eyes, mouth, tongue, throat, neck, chest and heart all normal. Abdomen : Liver and spleen enlarged almost down to the umbilicus, both firm and not tender. Limbs normal. No lymphadenopathy.

Investigations.—Temperature: an evening rise (99–101° F.). E.S.R. 45 mm./1st hr. W.B.C. 4,000/c.mm. (repeated) (polys. 27 per cent, lymphos. 67 per cent, monos. 5 per cent, eosinos. 1 per cent, basos. 0 per cent); Hb. 70 per cent; R.B.C. 3·9 million/c.mm.; C.I. 0·9. Blood film—no abnormality seen. Sternal puncture—no abnormality seen. Blood Kahn negative. Chest X-ray—N.A.D. Plasma proteins—total 9·0 grammes per cent. Albumin 3·2 grammes per cent. Globulin 5·6 grammes per cent. Fibrinogen 0·2 gramme per cent. Napier's formol-gel test positive. Blood culture for Leishmania positive. (Chopra's test was not performed.)

The results of the investigations prove conclusively the diagnosis of leishmaniasis. There can be no doubt that the infection was contracted from sandfly bites while the patient was resident in Malta. She was discharged from hospital on June 11 to continue treatment under the Unit M.O. Treatment will consist of intramuscular injections on alternate days of " Neostan " (Stilsenyl glucoside) to a total of 10 injections. The investigations will be repeated three months after the termination of treatment to ascertain cure.

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SKI TRAINING

BY

Captain P. W. HARVEY
Royal Army Medical Corps

During the winter, I was sent upon a course at the Mountain Commando training centre of the Chasseurs Alpins in the Rheine and Danube Command of the French Army.

The training school was situated at Hershegg in the Kleine Wassental in the Voralberg of Austria. It was administered from Baden-Baden in Germany.

The Chasseurs Mountain Commandos are carefully chosen physically. I gather that the medical standards for the French Army are not as high as those demanded by the British Army. As far as the British Army is concerned, these would be P2, P1 or L1.

The main points about the leg are the ligaments of the ankle-joint, and the internal lateral ligament of the knee-joint. Any injury of these ligaments seems to result in considerable loss of training time.

The French doctor practised injection of percaine 2 per cent into any of these ligaments when they were damaged. The limb was totally immobilized for three days. Then the injection took place and active movements began immediately. The patient returned to light duty in ten days altogether, but no strenuous ski-ing was permitted for three weeks.

I suspect that if a large number of British troops had been on this course, many of them would have been returned to unit, as the minor injuries to the internal lateral ligament of the knee-joint which are endemic amongst football players seems to be sufficient to prevent vigorous ski-ing.

It was interesting to note that none of the N.C.O.s completed the course without considerable loss of training time, and all the officers were reminded of old injuries to one or other of the joints in their lower limbs.

The French maintain the strictest discipline during ski training. All the officers on the course spoke French to some extent, and thus the instructors were able to control them. However, the N.C.O.s spoke only English and German, the French could speak no English, and consequently the control of the N.C.O.s squad left much to be desired. They were a group of individualists, controlled by signs and gestures, which contrasted with the orderliness of the officers' class.

The N.C.O.s thoroughly enjoyed themselves, and caused much amusement, but the tragedy was that 3 Regular N.C.O.s received serious injuries—two fractures of the ankle-joint region, and one very severe " sprain " of the knee-joint—out of 5 N.C.O.s.

Clothing and Equipment

The Chasseurs spent one whole day, and 3 officers and 12 other ranks were employed, in fitting the British party of 11.

They have special tables to decide the correct length of ski for a person.

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We were issued with steel-edged "downhill" skis, with Kandahar bindings. which are standard equipment in the Chasseurs Alpins.

The boots were the most carefully fitted of all. They had steel plates incorporated in their soles, and were made of thick leather. They were not dubbinned, but were waxed weekly in order that the leather might be waterproof but rigid. They laced back and front, and were cut low so as to leave full movement of the ankle-joint. The idea was that when boots and skis had been properly fitted, there should be *no* "play" between the foot and ski whatsoever.

The trousers were closely woven so as to be waterproof, and the Chasseurs themselves wore "Pantalons Fuseau" (fig. 1) which permit unhindered bending of the knees and have a fitting which keeps them in place round the ankle.

On the torso, we had a woollen vest and an anorak (fig. 2). The anorak was made of tightly woven Burberry-like material and came as low as the crutch, but was gathered in at the waist by a string acting like a pyjama girdle. The anorak hood was of much more ample proportions than any I had previously seen, thus enabling it to be easily raised or lowered.

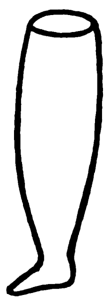

Fig. 1.

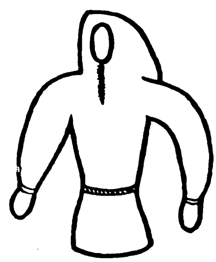

Fig. 2.

The anorak had a zip from the manubrium sternum up to the chin, and a string round the edge of the hood so that part of the face exposed could be reduced almost to the size of a half-crown. Thus with goggles, complete protection of the face was easily achieved and maintained.

Two pairs of gloves were issued, of raw wool, and "Burberry," "thumb and finger" gloves.

Whenever possible, the Chasseurs insisted that the whole of the head and neck should be completely naked (no mufflers), but they never permitted us to bare our arms or hands in case of a fall, causing "snow burns" of the arms.

The Quartermaster's Store was heated, and the temperature carefully controlled summer and winter. The skis were in racks, secured together with a block just behind the bindings, and with adjustable splints to keep the spatula from warping.

The boots were stuffed with hay. An officer actively engaged in ski-ing, inspected the kit weekly, and the Commandant of the Training Centre visited the stores once or twice a week. Their inspection was most thorough.

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Similar attention was paid to the ropes, etc., which are used in summer for rock-climbing.

The Chasseurs considered that leisure was just as important as the periods of instruction. No men who were learning to ski or doing any serious ski-training, were detained on fatigues, nor were they put on any but the minimum of parades and lectures.

Capitaine Donyac, the Commandant of the Training School, said:

"The Barrack Square spoils ski-training, it is all right before the course, and after it, or when they are competent, but not while they are learning."

To begin with, say for the first week, ski-ing is only for half an hour each morning and afternoon, rising to three hours in both morning and afternoon at the end of three weeks. Ski-ing was *forbidden* to all men under instruction, on Wednesday afternoons, and throughout Sunday. This is to give the muscles and joints a rest. The British students discovered how necessary this was by ignoring it the first Sunday. At all times during the first fortnight or so, all students were saved exertion to and from the ski-ing slopes, by buses, etc.

The morning was devoted to exercises and instruction, and in the afternoon a ski lift was used to enable as much practice as possible to be got in.

The quarters for the privates under instruction were as good as any I have seen for British Troops in Germany. The kitchen was spotless. There were ample welfare facilities, but the students were not allowed to drink excessively, or to stay up late, except on Saturday nights.

The diet for all skiers was 5,000 calories per day. It contained much fat, and was nothing like as bulky as the normal British Scale I ration. It was made up mostly of butter, cheese, meat, and sugar. Legumes, bread and potatoes were reduced to a minimum, as they are bulky, and produced too much wind. Chocolate and cocoa were issued only in small quantities, as they were considered too indigestible at high altitudes. We were encouraged to eat little and often.

All those British people who went to Ehrwald noticed that our physical capabilities fell off rapidly as soon as we transferred to Scale I rations, even though this was reinforced by a fantastic quantity of NAAFI buns. We also found ourselves horribly distended with starch.

There is no doubt that much of the energy and dash of the Chasseurs Alpins is due to their special diet. Alcohol was strictly rationed, and only permitted *after* the day's ski-ing.

THE "TRAINEAU POURCIER"

BY

Captain P. W. HARVEY

Royal Army Medical Corps

THE evacuation of wounded from the mountains has been occupying the minds of mountaineers for many years, and continental ski journals contain many references to the problem.

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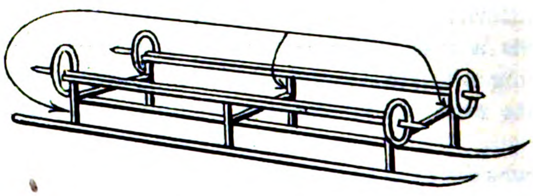
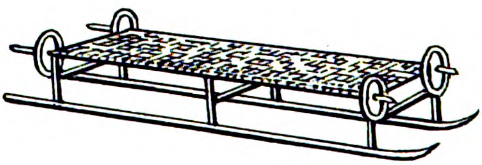
The Chasseurs Alpins to whom I talked are generally of the opinion that no satisfactory apparatus yet exists which can be carried by a small party in the mountains, and is yet capable of transferring a wounded or injured man from some inaccessible cliff face to that point to which a Jeep ambulance can penetrate.

The French feel that the Austrian mountain troops, during the recent war, had the most efficient material in this respect, though it was not ideal. Their apparatus was of various types.

In winter, the Chasseurs are satisfied that they have an efficient method of evacuating wounded and injured from the mountains. It is the "Traineau Pourcier." The actual equipment to be carried weighs about 3 kilos, and





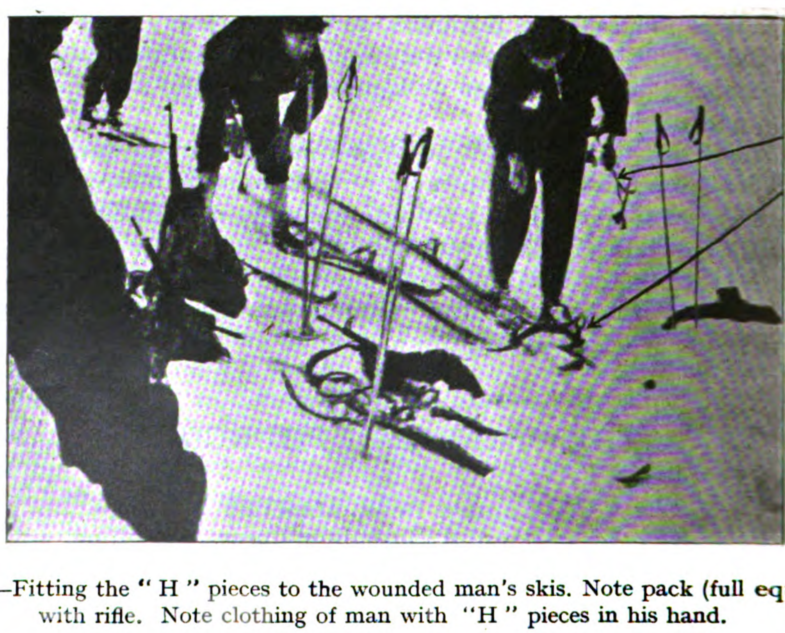


FIG. 1.—Fitting the "H" pieces to the wounded man's skis. Note pack (full equipment) with rifle. Note clothing of man with "H" pieces in his hand.

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FIG. 2.—Fitting the ski sticks. Again note rucksac and rifle in the background. The rifle is strapped to the rucksac which acts as a " rest " in action

FIG. 3.—Fitting the canvas top to the " traineau."

FIG. 4.—Strapping the wounded man to the completed sledge.

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consists of 3 " H " like pieces of metal in a canvas bag. The wounded man's skis form the runners of the sledge (repaired, if necessary, by a duraluminium spatula, or other material carried by the " ski cobbler " of the party).

The top of the sledge on which the wounded man lies is made up of a framework of 4 ski sticks, two belonging to the wounded man, and two more, either spares or else belonging to the four men who control the traineau when it is made up.

The canvas bag, in which the 3 " H " like pieces of metal were carried, forms the top of the traineau on which the patient lies.

I have carried the pieces myself, and found them to be not unduly heavy. I have seen trained and untrained Chasseurs erect the apparatus with surprising rapidity in about seven minutes for five soldiers, who had seen it done only once before.

Four skiers can control this sledge over the most difficult terrain with ease.

The Chasseurs also favour it as a store sledge, since it is light and mobile, and can be dismantled and used to replace damaged skis or ski sticks. They now regard the Nansen sledge as a museum piece.

Reviews

AIDS TO ANÆSTHESIA. Second Edition. By Victor Goldman, L.R.C.P., M.R.C.S., D.A. London: Baillière, Tindall and Cox. Pp. viii + 316, with 85 Illustrations. Price 7s. 6d.

This small book is intended primarily for medical students and the " occasional anæsthetist." It presents the subject in a concise though necessarily superficial form.

The second edition has been brought fully up to date with modern methods and should be useful to General Duty Medical Officers, to whom the chapter on " Anæsthesia in the Tropics " and the " Appendix of Useful Information " may well prove of particular value. K. F. S.

A SHORT PRACTICE OF SURGERY. Eight Editions in 5 Parts. By Bailey and Love. Parts 1 and 2. Published by H. K. Lewis & Co., Ltd. Pp. x + 232. 259 Illustrations, of which 89 are coloured. Price £2 12s. 6d. the set (not sold separately).

This well-known textbook is to be published in five parts. Parts 1 and 2 have been received to date. Part 1 contains chapters on general surgery, the face, mouth and tongue, neck and thyroid gland. Part 2 is devoted largely to the surgery of the abdomen. The amount of information compressed into the available space is remarkable. The text is well presented and very readable. With a few exceptions, the illustrations, of which many are in colour, are outstandingly good. Figs. 68 and 453 on pages 88 and 365 would appear to

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have little value. Fig. 518 is, I think, rightly apologized for in the text. Some of the diagrams are perhaps almost too highly coloured and over-simplified.

Of the matter presented, the encouragement of the use of Battle's incision is surely questionable.

To " honour the physician " is a worthy theme indeed but, to my way of thinking, is overplayed and here largely defeats its own object. That the giants of the past and present should be appraised is both meet and right, but many of the giants included are of meagre stature indeed. Does it really matter, except to the shareholder, who Benger was ? (page 415). Also I found irritating the repetition of the name (three times in Part 2) quoted at the bottom of the page.

For those requiring to rapidly revise their knowledge of current surgical practice, and for examination candidates, the five volumes should be of the greatest value, especially if read in conjunction with the well-known " Physical signs " by the same author, which is now being reissued in a new edition concurrently with the " Short Practice." D. C. McC. E.

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